1342

# INSTRUCTION MANUAL
# OSCILLOSCOPE
# MODEL 5650

Kikusui
INTERNATIONAL CORP.

# MODEL 5650
# OSCILLOSCOPE

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# 1. GENERAL

Kikusui Model 5650 Oscilloscope is a general-purpose dual-channel portable oscilloscope with a 6-inch rectangular type internal-graticule 80 mm × 100 mm (3.15 in. × 3.94 in.) cathode-ray tube.

The vertical axis has a maximum sensitivity of 1 mV/DIV (when in the "5 × MAG" mode) and a frequency response of up to 50 MHz (-3 dB). A X-Y mode of operation can be attained in a one-touch control operation.

The trigger circuit is capable of selecting six different types of signal sources. It incorporates with an alternate trigger function and a level lock function which facilitate and simplify the trigger operation.

The sweep time range is as wide as 0.5 sec - 0.1 μsec. The maximum sweep speed is 10 nsec/DIV (when in the "10 × MAG" mode). A sweep delay and alternate sweep function are included enabling parallel observation of the magnified waveform and non-magnified waveform. Also incorporated is a variable trigger hold off function which simplifies observation of sophisticated waveforms or digital signals of irregular repetitions.

# 2. SPECIFICATIONS

Vertical Axis

| Item | Specification | Remarks |
|---|---|---|
| Sensitivity | 5 mV/DIV - 5 V/DIV<br>1 mV/DIV - 1 V/DIV (with 5 × MAG) | 1-2-5 sequence, 10 ranges. |
| Sensitivity accuracy | ±3% or better<br>±5% or better (with 5 × MAG) | When VARIABLE knob in CAL'D position |
| Variable vertical sensitivity | To 1/2.5 or less of panel-indicated value | |
| Frequency response | DC: DC - 50 MHz<br>DC - 10 MHz (with 5 × MAG)<br>AC: 2 Hz - 50 MHz<br>2 Hz - 10 MHz (with 5 × MAG) | With reference to 50 kHz, 8 DIV. within -3 dB |
| Rise time | Approx. 7 nsec<br>(Approx. 35 nsec when in "5 × MAG") | |
| Signal delay time | Approx. 40 nsec<br>(with delay line of approx. 120 nsec) | Displayable section of waveform before trigger point |
| Square wave characteristics | Overshoot: 3% or less<br>Ringing: 2% or less<br>Sag: 2% or less | DC coupling, 4 DIV amplitude 200 kHz<br>(20°C - 35°C (68°F - 95°F)) |
| Input coupling | AC, DC, GND | |
| Input impedance | 1 MΩ±2%, 20 pF ±2 pF | |
| Maximum allowable input voltage | 400 Vp-p (DC + AC peak) | Frequency 1 kHz or lower |
| Polarity switching | Channel 2 only | |
| DC balance shift | ±0.5 DIV<br>±2.0 DIV (with 5 × MAG) | |
| operation modes | CH1, CH2, CHOP, ALT, ADD,<br>X-Y (CH1 — X, CH2 — Y) | |

| Item | Specification | Remarks |
|---|---|---|
| CHOP frequency | Approx. 500 kHz | |
| Common mode signal rejection ratio | 50:1 or better, at 50 kHz sinusoidal wave | With uniform sensitivities of CH1 and CH2 |
| Isolation between channels | At least 1000:1 at 50 kHz<br>At least 30:1 at 50 MHz | At 5 mV/DIV range (without CHOP mode) |

CH1 Signal Output

| Item | Specification | Remarks |
|---|---|---|
| Output voltage | Approx. 20 mV/DIV into 1 MΩ load<br>Approx. 10 mV/DIV into 50Ω load | One division of deflection gives approx. output voltage. |
| Output resistance | Approx. 50Ω | |
| Output frequency response | DC - 35 MHz, -3 dB | At 50Ω terminated |
| Output DC level | Approx. 0 V | |

Trigger A and B (A: Main sweep, B: Delayed sweep)

| Item | Specification | Remarks |
|---|---|---|
| Trigger signal source | A: INT, LINE, EXT, EXT ÷ 10<br>INT (CH1, CH2, NORM)<br>B: INT, EXT | When in NORM, triggering is ALT TRIG.<br>B EXT terminal is on rear panel. |
| Coupling mode | A: AC, HF REJ, TV, DC<br>B: AC only | When in TV, signal is connected to trigger circuit after synchronization signal separation. |
| Slope | "+" and "-" | Both A and B |
| A trigger sensitivity | AC: 10 Hz - 10 MHz<br>0.4 DIV (0.04 V)<br>3 Hz - 50 MHz<br>1.0 DIV (0.1 V)<br>DC: DC - 10 MHz<br>0.4 DIV (0.04 V)<br>DC - 50 MHz<br>1.0 DIV (0.1 V)<br>HF REJ: 10 Hz - 50 kHz<br>1.0 DIV (0.1 V) | Figures enclosed in brackets indicate EXT input trigger voltage sensitivities. |

| Item | Specification | Remarks |
|---|---|---|
| | TV: Video signal<br>1.0 VID (0.1 V) | |
| B trigger sensitivity | 10 Hz - 10 MHz<br>0.4 DIV (0.04 V)<br>3 Hz - 50 MHz<br>1.0 DIV (0.1 V) | AC only |
| AUTO operation | Satisfies the trigger sensitivity specification for signal repetition frequency of 50 Hz or over. | |
| NORM | When no trigger signal input is applied, trace is blanked out and is in the READY state. | Satisfies the specification of trigger sensitivity. |
| SINGLE | One-shot sweep with trigger signal. Can be reset to the READY state by means of RESET switch. | |
| LEVEL LOCK | Satisfies the values mentioned in the above items of trigger sensitivity plus 0.5 DIV (0.05 V), for a signal of duty cycle 1:5 - 5:1 and repetition frequency 50 Hz or over. | When in TV sync trigger, usable with video signal amplitude of 0.5 - 2.0 DIV. |
| External input impedance | A: Approx. 1 MΩ, 30 pF or less<br>B: Approx. 1 MΩ, 35 pF or less | |
| Maximum allowable input voltage | 100 V (DC + AC peak) | AC: 1 kHz or lower |

Horizontal Axis

A sweep and B sweep

| Item | Specification | Remarks |
|---|---|---|
| Sweep time | 0.1 μsec - 0.5 sec/DIV<br>10 nsec - 50 msec/DIV<br>(when in "10 × MAG") | 1-2-5 sequence,<br>21 ranges. |
| TIME/DIV variable (sweep time) | Can be varied (made slower) from panel- indicated value by a factor of 2.5 or over. | For A sweep only |

| Item | Specification | Remarks |
|---|---|---|
| Sweep time accuracy | ±3% or better<br>±5% or better (when in "10 × MAG") | |
| Linearity | 3% or better<br>5% or beter (when in "10 × MAG") | |
| Position shift caused by sweep magnification | Within ±0.5 DIV at CRT center | |
| Sweep mode | A, A INTEN, ALT, B | |

Sweep Delay

| Item | Specification | Remarks |
|---|---|---|
| Delay system | Continuous delay or Triggered delay | |
| Sweep delay time | 5 sec - 1 $\mu$sec | |
| Sweep delay time accuracy | Within ±3% on CRT<br>Within ±3% of multi-dial indication (excluding 0 - 0.50) | |
| Delay jitter | 1/10,000 or less<br>$\frac{\text{B sweep time}}{\text{A sweep time}} \times \frac{\text{jitter width}}{\text{10 DIV}}$ | Jitter width 1.0 DIV or less at<br>A: 1 msec/DIV and<br>B: 1 $\mu$sec/DIV |

External Sweep

| Item | Specification | Remarks |
|---|---|---|
| Mode | X-Y mode<br>CH1 ... X axis (HOR.)<br>CH2 ... Y axis (VERT.) | |
| Sensitivity | 5 mV - 5 V/DIV | The same as CH1 |
| Sensitivity accuracy | ±3% or better | The same as CH1 |
| Frequency response | AC: 2 Hz - 2 MHz<br>DC: DC - 2 MHz | With reference to 50 kHz, -3 dB |
| X-Y phase difference | 3° or less (DC - 50 kHz) | |

Z Axis

| Item | Specification | Remarks |
|---|---|---|
| Sensitivity | 3 Vp-p<br>(Trace becomes brighter with negative input.) | |
| Frequency response | DC - 5 MHz | |
| Input resistance | Approx. 5 kΩ | |
| Maximum allowable input voltage | 50 Vp-p (DC + AC peak) | AC: 1 kHz or less |

CRT

| Item | Specification | Remarks |
|---|---|---|
| Type | 6-inch rectangular type, internal graticule | |
| Fluorescent screen | P31 | Green |
| Acceleration voltage | Approx. +8.5 kV / -1.5 kV | Approx. 10 kV |
| Effective CRT screen size | 8 × 10 DIV | 1 DIV = 1 cm<br>(0.39 in.) |
| Graticule | Internal graticule,continuously variable illumination | |
| Unblanking | DC coupling | |

Calibration Voltage

| Item | Specification | Remarks |
|---|---|---|
| Waveform | Positive-going square wave | |
| Frequency | Approx. 1 kHz | |
| Duty ratio | Within 45:55 | |
| Output voltage | 2 V ±2%<br>200 mV ±2% | |
| Rise time | Approx. 0.1 μsec | |
| Output resistance | 2 V: approx. 2 kΩ<br>200 mV: approx. 200Ω | |

Power Requirements

| Item | Specification | Remarks |
|---|---|---|
| AC line voltage ranges | A: 90 - 110 V<br>B: 104 - 126 V<br>C: 194 - 236 V<br>D: 207 - 253 V | Voltage ranges are selectable with selector plug. |
| Frequency | 50/60 Hz | |
| Power consumption | Approx. 55 VA | |

Mechanical Specification

| Item | Specification | Remarks |
|---|---|---|
| Dimensions of main body alone | 310 W × 150 H × 400 D mm<br>(12.20W × 5.91H × 15.57D in.) | |
| Maximum dimensions | 370 W × 190 H × 480 D mm<br>(14.57W × 7.48H × 18.90D in.) | With handle on top of casing |
| Weight | Approx. 9.7 kg (21.4 lb.) | |

Ambient Conditions

- o Normal operating ranges: Temperature ..... 5°C - 35°C (41°F - 95°F)
  Humidity ..... 85% RH max.
- o Maximum operating ranges: Temperature ..... 0°C - 40°C (32°F - 104°F)
  Humidity ..... 90% RH max.

Accessories:

- o 959A BNC probes (10:1, 1 m) ..... ( 89-03-0180 ) ..... 2
- o 942A terminal adaptor ..... ( W4-986-011 ) ..... 1
- o Slow blow fuse, 0.5 A ..... ( 99-02-0115 ) ..... 1
- o Slow blow fuse, 1 A ..... ( 99-02-0120 ) ..... 1
- o Power cord ..... ( ) ..... 1
- o Short bar ..... ( ) ..... 1
- o Instruction manual ..... ( ) ..... 1

## 3.1 Notes in Operation

o AC line voltage:

This instrument can be operated on any one of the AC line voltages shown in the following table. The required voltage can be selected by means of the voltage selector plugs. Before operating the instrument, ensure that the AC line voltage setting of the instrument conforms with the voltage of the AC line on which the instrument is to be operated. If the instrument voltage does not conform with the line voltage, the instrument may not operate normally or may be permanently damaged.

When the instrument AC line voltage is changed, change the fuse also referring to the follwing table.

| Symbol | Center voltage | Operating voltage range | Fuse |
|---|---|---|---|
| A | 100 V | 90 - 110 V | 1 A |
| B | 115 V | 104 - 126 V | slow blow |
| C | 215 V | 194 - 236 V | 0.5 A |
| D | 230 V | 207 - 253 V | slow blow |

o Environments:

The normal ambient temperature range of this instrument is 5°C - 35°C (41°F - 95°F). Operation of the instrument outside of this temperature range may cause damage to the circuits.

Do not use the instrument in a place where strong magnetic or electric field exists. Such fields may disturb the measurement.

o CRT intensity:

In order to prevent permanent damage to the CRT, do not make the CRT trace excessively bright or leave the spot stationary for more than a few moments.

o Withstanding voltages of input terminals:

The withstanding voltages of the instrument input terminals and probe input terminals are as shown in the following table. Do not apply voltages higher than these limits.

| | |
|---|---|
| CH1, CH2 inputs | 400 Vp-p (DC + AC peak) |
| Probe input | 600 Vp-p (DC + AC peak) |
| EXT TRIG input | 100 Vp-p (DC + AC peak) |
| Z AXIS input | 50 Vp-p (DC + AC peak) |

Note: AC Frequency is 1 kHz or below.

## 3.2 Explanation of Front Panel (See Figure 1.)

o CRT circuits:

POWER ..... (21) Main power switch of the instrument. When this switch is turned on, lamp (22) is also turned on.

INTEN ..... (23) Controls the brightness of the spot or trace.

B INTEN ..... (24) Semi-fixed potentiometer for adjusting the intensified sweep or B sweep brightness.

FOCUS ..... (25) For focussing the trace to the sharpest image.

ILLUM ..... (27) Graticule illumination adjustment.

TRACE ROTATION ..... (26) Semi-fixed potentiometer for aligning the horizontal trace in parallel with graticule lines.

o Calibration Voltage:

CALIB 2 V ..... (29) Terminal for 2 V calibration voltage output. Output resistance is approximately 2 kΩ.

200 mV ..... (28) Terminal for 200 mV calibration voltage output. Output resistance is approximately 200 Ω.

o Vertical axis:

CH1 (X) input ..... ⑨ Vertical input terminal of CH1. When in X-Y operation, X axis (abscissa) input terminal.

CH2 (Y) input ..... ⑮ Vertical input terminal of CH2. When in X-Y operation, Y axis (ordinate) input terminal.

GND ..... ⑪ Ground terminal of instrument

AC-GND-DC ..... ⑧ ⑯ Switch for selecting connection mode between input signal and vertical amplifier.

AC: AC coupling

GND: Vertical amplifier input is grounded and input terminals are disconnected.

DC: DC coupling

VOLTS/DIV ..... ⑤ ⑬ Select the vertical axis sensitivity, from 5 mV/DIV to 5 V/DIV with 10 ranges.

VARIABLE ..... ⑥ ⑭ Fine adjustment of sensitivity, with a factor of 1/2.5 or over of panel-indicated value. When in the CAL'D position, sensitivity is calibrated to panel-indicated value. When not in the CAL'D position, the UNCAL lamp ③ or ⑲ turns on.

POSITION ..... ⑦ ⑫ Vertical position control of the trace or spot.

5 × MAG ..... ④ ⑰ Magnifies by 5 times the sensitivity of vertical amplifier. When in this mode, the "5 × MAG" lamp ② or ⑳ turns on

CH2 POLARITY ..... (18) This switch selectes the polarity of the signal applied to CH2 input terminal. The ▮ state is the normal polarity and the ▁ state is the inverted polarity.

VERT MODE ..... (1) Selects the operation mode of the vertical axis.

CH1: CH1 alone operates.

CH2: CH2 alone operates.

ALT: Dual-channel operation with CH1 and CH2 swept alternately. Suitable for observation with fast sweep speed.

CHOP: Dual-channel operation with CH1 and CH2 chopped at a frequency of approximately 500 kHz. Suitable for observation with slow sweep speed.

ADD: For measurement of algebraic sum or difference of CH1 and CH2 signals, employing the function of CH2 POLARITY switch.

X-Y: X-Y operation with CH1 for X axis and CH2 for Y axis.

INT TRIG ..... (10) Selects the internal trigger signal source. The signal selected by this switch is fed to the A trigger circuit if SOURCE switch (37) is set in the INT state or to the B trigger circuit if SOURCE switch (54) of rear panel is set in the INT state.

CH1: Input signal of CH1 is used as trigger signal.

CH2: Input signal of CH2 is used as trigger signal.

NORM: Input signal which is displayed on CRT screen is used as trigger signal. When in the ALT mode, triggering also is in an alternate mode and the signals of both CH1 and CH2 are alternately used for triggering respective channels.

o Trigger Circuit:
(Refer to explanation of the rear panel for B trigger.)

EXT TRIG INPUT ..... (35) Input terminal for external trigger signal.

SOURCE ..... (37) Selects the trigger signal.

INT: Internal signal selected by INT TRIG switch (10) is used as trigger signal.

LINE: AC line signal is used as trigger signal.

EXT: Input signal of EXT TRIG INPUT terminal (35) is used as trigger signal.

EXT ÷ 10: Input signal of EXT TRIG INPUT terminal is attenuated to by a factor of 1/10 and used as trigger signal.

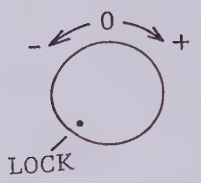
COUPLING ..... (36) Selects coupling mode between trigger source circuit and trigger circuit and also selects connection mode for the TV sync. circuit.

AC: Trigger signal is applied through an AC coupling circuit.

HF REJ: Trigger signal is applied through an AC coupling circuit, with attenuation of signal components higher than 50 kHz.

TV: TV sync. separation circuit is connected to the trigger circuit, and the sweep is triggered in synchronization with TV.V or TV.H signal at sweep speed selected by the A TIME/DIV switch (45) .
TV.V: 0.5 sec - 0.1 msec/DIV
TV.H: 50 μsec - 0.1 μsec/DIV

LEVEL .....




(33) Controls the trigger level for setting the start point of displayed waveform. As this knob is turned in "→+" direction, the trigger level moves upward on the displayed waveform; as the knob is turned "- ←", the level moves downward.

When set in the LOCK position, the trigger level is automatically maintained at an optimal value irrespective of the signal amplitude (from very small amplitude to large amplitude), requiring no manual adjustment of trigger level.

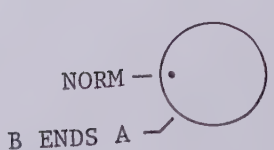
SLOPE .....

(32) Selects the triggering slope.

"+": Triggering occurs when the trigger signal crosses the trigger level in positive-going direction.

"-": Triggering occurs when the trigger signal crosses the trigger level in negative-going direction.

A HOLD OFF .....




(31) This knob is used when the signal waveform is complex and stable triggering cannot be attained with LEVEL knob (33) alone. When this knob is set in the "B ENDS A" position, the A sweep ends at the same time the B sweep ends.

With this function, degradation of brightness can be minimized when in the delayed sweep with large magnification of waveform in the horizontal direction.

TRIG'D ..... (42) When the A sweep operates, the TRIG'D lamp (42) turn on.

o Sweep Circuits

A, B TIME/DIV ..... (45)
AND DELAY TIME (46)

The large knob (45) is for A TIME/DIV and DELAY TIME, and the medium knob (46) is for B TIME/DIV.
The A TIME/DIV knob sets the A sweep rate; the DELAY TIME knob sets the delaying sweep rate.
The B TIME/DIV switch sets the delayed sweep rate.

A VARIABLE ..... (44) Continuously-variable adjustment of A sweep rate. Value indicated by A TIME/DIV switch (45) can be reduced by a factor of 2.5 or more. When set in the CAL'D position, the sweep speed is calibrated to the value indicated by the A TIME/DIV switch. When not in the CAL'D position, the UNCAL lamp (41) turns on.

10 × MAG ..... (39) The A or B sweep is expanded by 10 times and, therefore, the sweep time becomes 1/10. When in this operation, the "10 × MAG" lamp (38) turns on.

POSITION ..... (47) Horizontal position control of spot or trace.
←→

FINE ..... (48) Fine adjustment of horizontal positioning. Especially useful when in the "10 × MAG" operation.

DELAY TIME MULTI ..... (49) Multi-turn potentiometer for continuously variable adjustment of the delay time indicated by the A sweep knob (45) in order to select the section to be expanded of the A sweep.

SWEEP MODE ..... (43) Selects the desired sweep mode.

AUTO: When no adequate triggering signal is applied or when signal frequency is less than 50 Hz, sweep runs automatically.

NORM: When no adequate triggering signal is applied, sweep is in a ready state and the return trace is blanked out. Used primarily for observation of signals of 50 Hz or lower.

SINGLE: Used for single sweep operation (PUSH TO RESET) (one-shot sweep operation) in conjunction with the reset switch.

When the three buttons are in the pushed out state, the circuit is in the single sweep mode. The circuit is reset as this button is pressed. When the circuit is reset, the READY lamp (40) turns on. The lamp goes off when the single sweep operation is over.

HORIZ DISPLAY ..... (50) Selects A and B sweep mode as follows:

A: Main sweep (A sweep) mode for general waveform observation.

A INTEN: This sweep mode is used when selecting the section to be magnified of the A sweep. The B sweep section (delayed sweep) corresponding to the A sweep is displayed with high brightness.

ALT: A sweep and B sweep (delayed sweep) are displayed alternately. (The A, B TRACE SEPARATION control (34) is used to set vertical separation so that the waveforms can be clearly observed.

B: Displays the delayed sweep (B sweep) alone.

B TRIG'D: Selects between continuous delay and triggered delay.

▮ : For continuous delay. Sweep starts immediately after the sweep delay time determined by DELAY TIME switch (45) and DELAY TIME MULTI knob (49), irrespective of B trigger signal.

▬ : For triggered delay. Sweep starts with B trigger signal after the sweep delay time determined by DELAY TIME switch (45) and DELAY TIME MULTI knob (49). (Controls for B trigger circuit are located on the rear panel.)

A, B TRACE SEPARATION ..... (34) Semi-fixed potentiometer for separating the vertical positions of the A and B sweeps when in the ALT mode.

## 3.3 Explanation of Rear Panel

o B Trigger Circuit

EXT TRIG INPUT ..... (51) Input terminal for external trigger signal of B sweep.

LEVEL ..... (52) Trigger level adjustment of B sweep. When set in the LOCK position, trigger level is automatically maintained irrespective of signal amplifude (from very small signal to large signal).

SLOPE ..... (53) Selects the slope for the triggering point of sweep.

SOURCE ..... (54) Selects the trigger signal for B sweep.

INT: Signal selected by INT TRIG switch (10) is AC coupled to B trigger circuit.

EXT: Input signal applied to EXT TRIG INPUT terminal (51) is AC coupled to trigger circuit.

o Z Axis

Z AXIS INPUT .... (55) (56) Input terminals for external intensity modulation signal. Binding post terminals with 19-mm (0.75 in.) spacing.

o CRT Circuit

ASTIG ..... (62) Astigmatism control of CRT. This control, in conjunction with the FOCUS control, should be so adjusted that the spot or trace displayed on the CRT screen is made sharpest.

o CH1 SIGNAL OUTPUT ... (63) This output terminal provides CH1 signal which is fed to a frequency counter, etc.

o AC Power Input Circuit

AC power input connector ..... (59)
Input connector of the AC power of the instrument. Connect the AC power cord (supplied) to this connector.

FUSE ..... (60) Fuse in the primary circuit of the power transformer. Fuse rating is as shown in the AC line voltage table (61) on the instrument rear panel.

AC voltage selecting connector ..... (57)
For selecting the AC voltage of the instrument in conjunction with selector plug (58)

AC voltage selector plug ..... (58)
For selecting the AC voltage of the instrument in conjunction with selector connector, as indicated with A, B, C, D symbols with reference to the AC line voltage table (61) on the instrument rear panel.

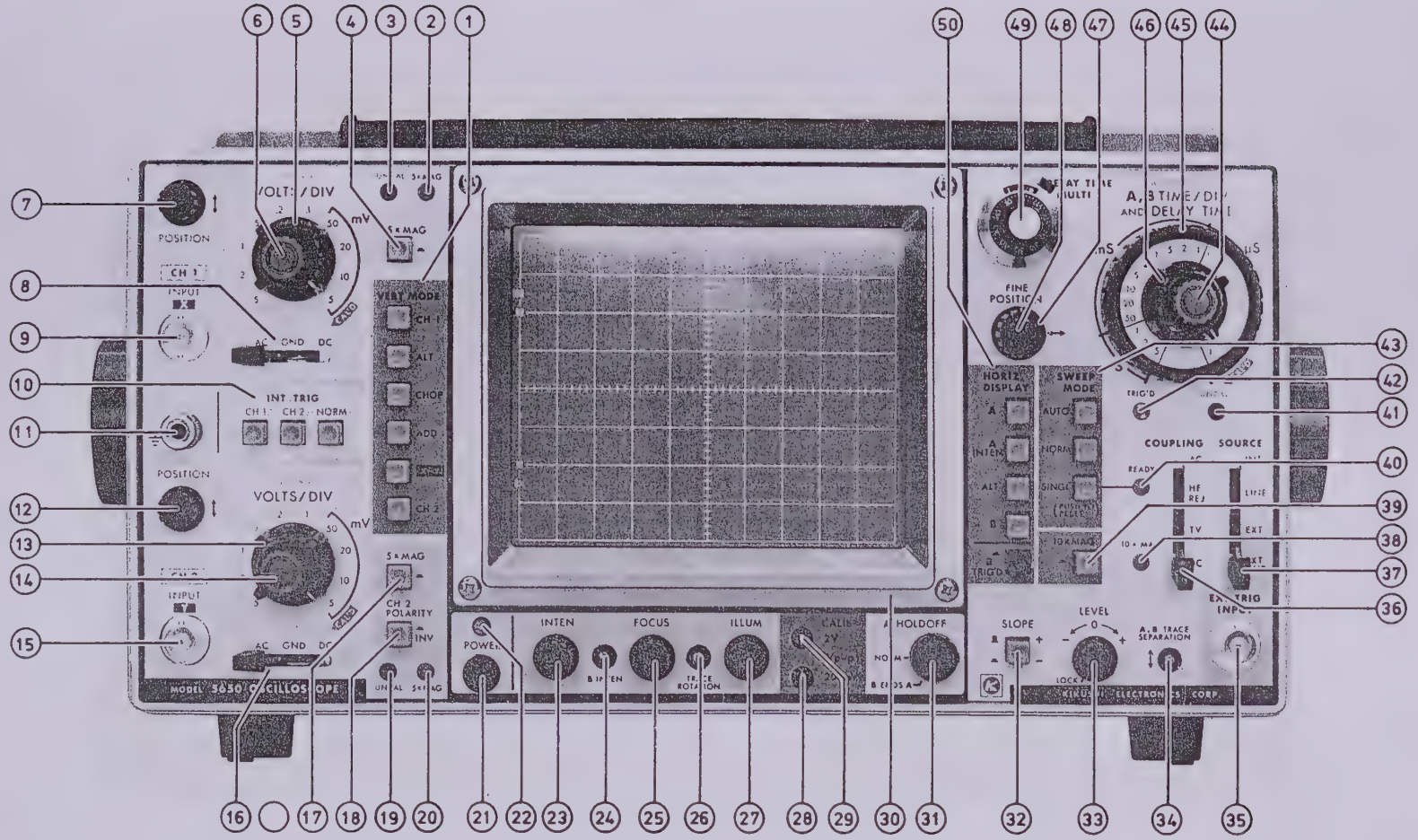



Figure 1. Front panel of the oscilloscope

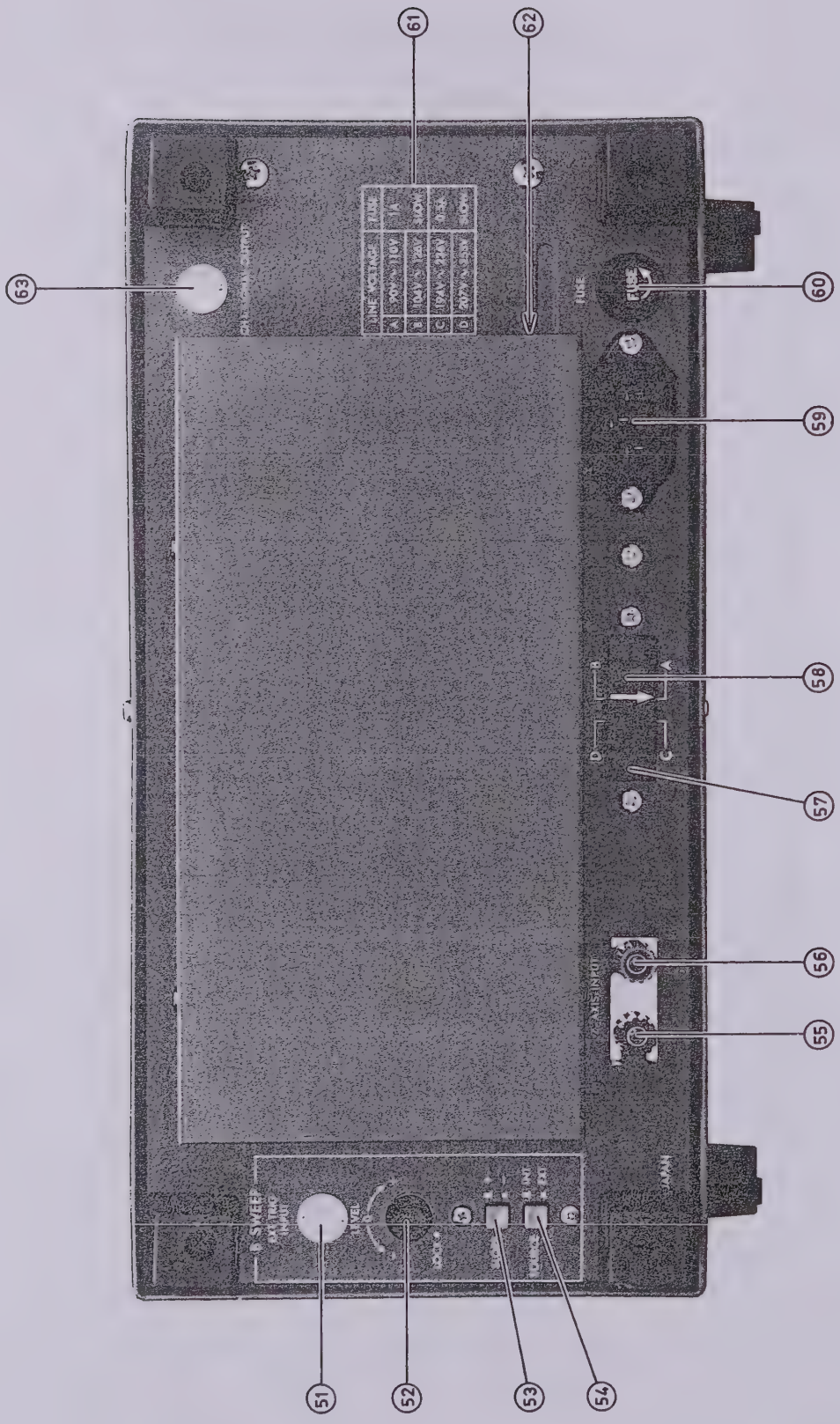



Figure 2. Rear panel of the oscilloscope

## 4.1 Basic Operation (Refer to Figure 1.)

Before connecting the power cord to an AC line outlet, check that the AC line voltage selector plug on the rear panel of the instrument correct set for the AC line voltage. After ensuring the voltage setting, set the switches and controls of the instrument as shown in the following table.

| Item | No. | Setting |
|---|---|---|
| POWER | ㉑ | OFF position |
| INTEN | ㉓ | Clockwise (3-o'clock position) |
| FOCUS | ㉕ | Mid-position |
| ILLUM | ㉗ | Counterclockwise position |
| VERT MODE | ① | CH1 |
| ↕ POSITION | ⑦ ⑫ | Mid-position |
| VOLTS/DIV | ⑤ ⑬ | 50 mV |
| VARIABLE | ⑥ ⑭ | CAL'D (clockwise position) |
| AC-GND-DC | ⑧ ⑯ | GND |
| 5 × MAG | ④ ⑰ | ▮ OFF |
| CH2 POLARITY | ⑱ | ▮ NORM |
| INT TRIG | ⑩ | NORM |
| SOURCE | ㊲ | INT |
| COUPLING | ㊱ | AC |
| LEVEL | ㉝ | LOCK (counterclockwise) |
| SLOPE | ㉜ | ▮ "+" |
| A HOLD OFF | ㉛ | NORM (counterclockwise) |
| SWEEP MODE | ㊸ | AUTO |
| HORIZ DISPLAY | ㊿ | A |

| Item | No. | Setting |
|---|---|---|
| 10 × MAG | ㊴ | ▮ OFF |
| TIME/DIV | ㊺ | 0.5 mS |
| VARIABLE | ㊹ | CAL'D (clockwise) |
| ⟷ POSITION | ㊼ ㊽ | Mid-position |

After setting the switches and controls as above, connect the power cord to the AC line outlet and, then, proceed as follows:

1) Turn-ON the POWER switch and ensure that the power pilot LED above is also turned on. In about 20 seconds, a trace will be appeared on the CRT screen. If no trace appears in about 60 seconds, repeat the switch and control settings as shown in the above table.

2) Adjust the trace to an appropriate brightness and sharpest image with the INTEN control and FOCUS control.

3) Align the trace with the horizontal center line of graticule by adjusting the CH1 POSITION control and TRACE ROTATION control (screw driver adjust).

4) Connect the probe (supplied) to the CH1 INPUT terminal, and apply the 200 mVp-p CALIBRATOR signal to the probe tip.

5) Set the AC-GND-DC switch in the AC state. A waveform as shown in Figure 3 will be displayed on the CRT screen.

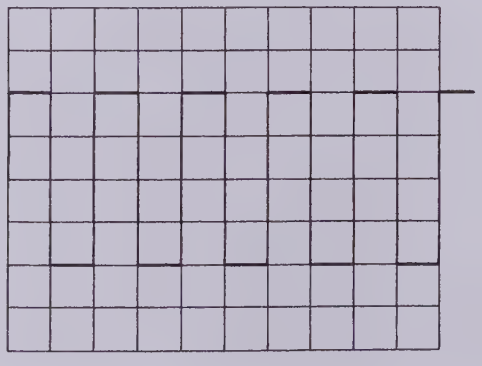


Figure 3

6) Adjust the FOCUS control so that the trace image becomes sharpest.

7) For signal observation, set the VOLTS/DIV switch and TIME/DIV switch in appropriate positions so that the signal waveform is displayed with an appropriate amplitude and an appropriate number of peaks.

8) Adjust the ↕ POSITION and ↔ POSITION control in appropriate positions so that the displayed waveform is aligned with the graticule and the voltage (Vp-p) and period (T) can be read conveniently.

The above is the basic operating procedure of the oscilloscope. Further operation methods are explained in the subsequent paragraphs.

## 4.2 Dual-channel Operation

Two signals can be simultaneously displayed on the screen by setting the VERT MODE switch in the CHOP state or the ALT state. By using these modes signals can be successfully displayed with sweeps at all sweep speeds.

(1) CHOP sweep (chopped sweep):
The signals of CH1 and CH2 are chopped at a frequency of 500 kHz and the chopped signals are displayed on the CRT screen. Therefore, if the sweep speed becomes as dotted lines, the ALT mode should be used.

(2) ALT sweep (alternate sweep)
This sweep mode is used primarily for observation of signals at faster sweep speeds, although it may be used also at slower sweep speeds when photographing the displayed waveforms or when particular trigger conditions are required.

At faster sweep speeds, the two waveforms are displayed as if they were running at the same time. At slower sweep speeds, the alternate actions of the two sweeps becomes discernible to human eyes and the displayed images flicker. In this case, the CHOP mode explained in the preceding paragraph should be used.

## 4.3 ADD Operation

An algebraic sum of the CH1 and CH2 signals can be displayed on the CRT screen by setting the VERT MODE switch in the ADD state. The displayed signal is the difference between CH1 and CH2 signals if the CH2 POLARITY switch is set in the ▬ INV state.

For accurate addition or subtraction, it is a prerequisite that the sensitivities of the two channels are adjusted accurately at the same value by means of the VAR knobs. Vertical positioning can be done with the ↕ POSITION knob of either channel. In view of the linearities of the vertical amplifiers, it is most advantageous to set them in their mid-positions.

## 4.4 Triggering

Proper triggering is essential for efficient operation of an oscilloscope. The user of the oscilloscope must make himself thoroughly familiar with the triggering functions and procedures.

(1) Functions of INT TRIG (internal trigger) switch:

The signals applied to the input terminals of CH1 and CH2 are picked off from respective preamplifiers in order to be used as internal trigger signals. The INT TRIG switch selects these signals. The selected signals are sent to the A trigger circuit or the B trigger circuit through the SOURCE switch. The relationship of these circuits is shown in the block diagram of Figure 4.

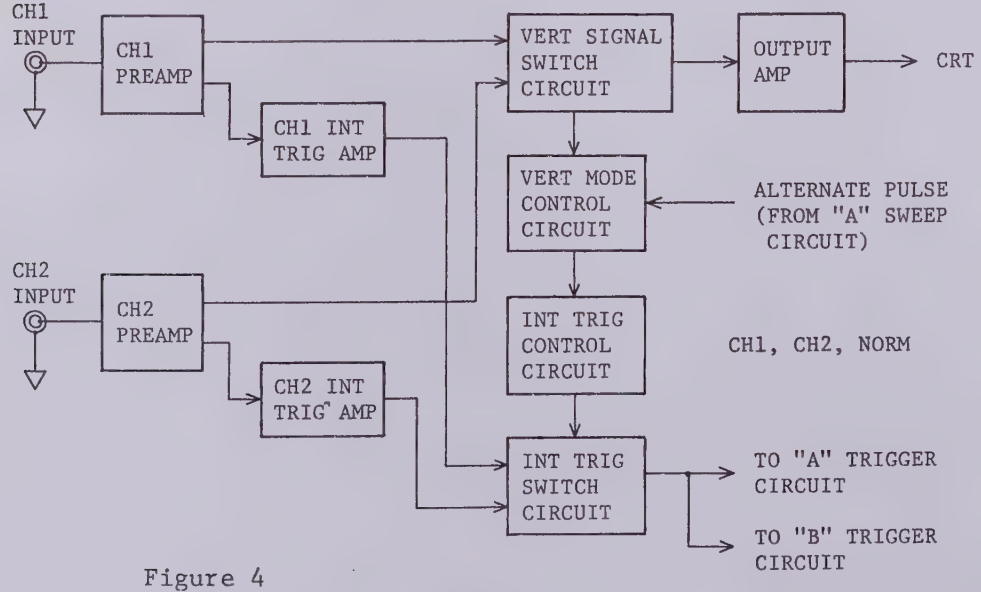



Figure 4

With the INT TRIG switch the internal trigger signal can be selected as follows.

CH1: Input signal of CH1

CH2: Input signal of CH2

NORM: Signal being displayed on CRT when in ALT mode

For further claritication see the following table.

| INT TRIG \ VERT MODE | CH1 | CH2 | CHOP | ALT | ADD | X-Y |
|---|---|---|---|---|---|---|
| CH1 | Triggered with CH1 | | | | | |
| CH2 | Triggered with CH2 | | | | | |
| NORM | Triggerd with CH1 | Triggerd with CH2 | - | *Alter-nate trigger | Triggerd with CH1 | - |

* Because the trigger circuit receives both input signals it is necessary to consider the DC level of both when in the ALT trigger mode.

(2) Functions of SOURCE Switch:

To display a stationary pattern on the CRT screen, the displayed signal itself or a trigger signal which has a time relationship with the displayed signal is required to be applied to the trigger circuit. The SOURCE switch selects such a trigger source.

INT: This internal trigger method is used most commonly. The signal applied to the vertical input terminal (the measured signal) is branched off from a point in the amplifier circuit and is fed to the trigger circuit through the INT TRIG switch. Since the trigger signal is the measured signal itself, a very stable waveform can be readily displayed on the CRT screen.

LINE: The AC power line frequency signal is used as the trigger signal. This method is effective when the measured signal has a relationship to the AC line frequency, especially for measurements of low level AC noise of audio circuits, AC line frequency controlled thyristor circuits, etc.

EXT: The sweep triggered with an external signal applied to the EXT TRIG INPUT terminal. An external signal which has a periodic relationship with respect to the measured signal is used. Since the measured signal (vertical input signal) is not used as the trigger signal, waveform display can be done independent of the measured signal.

EXT ÷ 10: The external trigger signal applied to the EXT TRIG INPUT terminal is attenuated into 1/10 before being applied to the trigger circuit. Operation is the same with those of the EXT trigger mode. This mode is used when the external trigger signal level is too high.

(3) Functions of COUPLING switch:

This switch is used to select the coupling of the trigger signal to the trigger circuit in accordance with the characteristics of the measured signal.

AC: This coupling is for AC triggering which is used most commonly. As the trigger signal is applied to the trigger circuit through an AC coupling circuit, stable triggering can be attained without being affected by the DC component of the input signal. The low-range cut off frequency is 3 Hz (-3 dB).

When the ALT trigger mode is used and the sweep speed is slow, jitter may be produced. In such a case, use the DC mode.

HF REJ: The trigger signal is applied to the trigger circuit through an AC coupling and a low pass filter circuit,

in order that the high frequency signal or noise components of the trigger signal is eliminated triggering is effected by the low frequency component alone.

TV: This coupling is for TV triggering for observation of TV video signals. The trigger signal is AC-coupled and fed via the trigger circuit (level circuit) to the TV sync separation circuit. The separation circuit picks off the sync signal and this is used to trigger the sweep. Thus, the video signal can be displayed very stably.

Being linked to the TIME/DIV switch, the sweep speed is switched for TV.V and TV.H as follows:

TV.V: 0.5 sec - 0.1 msec
TV.H: 50 $\mu$sec - 0.1 $\mu$sec

The SLOPE switch should be set in conformity with the video signal as shown in Figure 5.

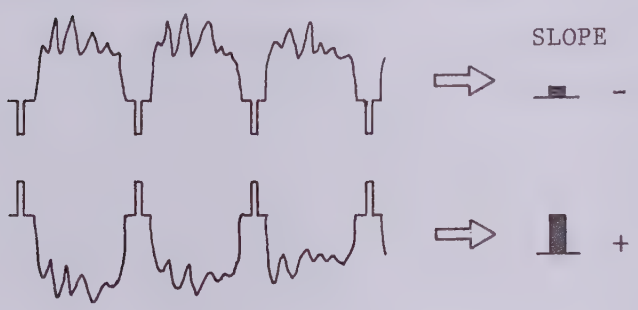



Figure 5

Note: The LEVEL LOCK is effective when the signal level is very low (2 DIV or less). When the signal level is higher than 2 DIV, release the LOCK and manually adjust the level.

DC: The trigger signal is DC-coupled to the trigger circuit. This mode is used when triggering is desired on the DC component of the trigger signal or when a very low frequency signal or a signal of a large duty cycle ratio is required to be displayed.

(4) Functions of SLOPE switch:

This switch selects the slope (polarity) of the trigger signal.

"+": When set in the "+" state, triggering occurs as the trigger signal crosses the trigger level in the positive-going direction.

"-": When set in the "-" state, triggering occurs as the trigger signal crosses the trigger level in the negative-going direction.

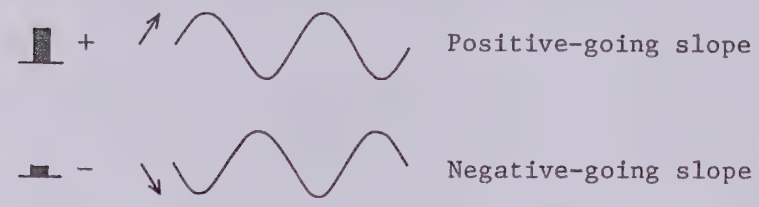



Figure 6

(5) Functions of LEVEL (LOCK) control:

The function of this control is to adjust the trigger level and display a stationary image. At the instant the trigger signal has crossed the trigger level set by this control, the sweep is triggered and a waveform is displayed on the screen.

The trigger level changes in the positive direction (upward) as this control knob is turned clockwise and it changes in the negative direction (downward) as the knob is turned counter-clockwise. The rate of change is set as shown in Figure 7.

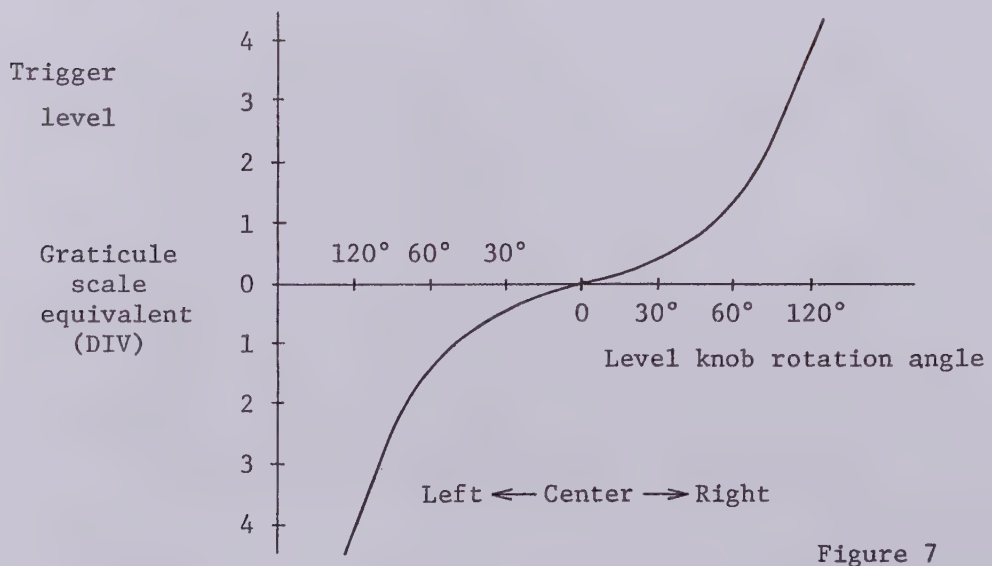



Figure 7

o LEVEL LOCK

When the LEVEL knob is set in the LEVEL LOCK position, the trigger level is automatically maintained at a stable trigger level by the level lock circuit, provided that the displayed signal level or the external trigger signal level is within the following range:

| | |
|---|---|
| 3 Hz - 50 MHz | 1.5 DIV (0.15 V) |
| 10 Hz - 10 MHz | 0.9 DIV (0.09 V) |

(6) Functions of A HOLD OFF control:

When the measured signal is a complex waveform with two or more repetition frequencies (periods), triggering with the above-mentioned LEVEL control alone may not be sufficient for attaining a stable waveform display. In such a case, the sweep can be synchronized to the measured signal waveform by adjusting the HOLD OFF time (sweep pause time) of the sweep waveform. The control covers at least the time of one full sweep, for sweeps faster than 0.2 sec/DIV.

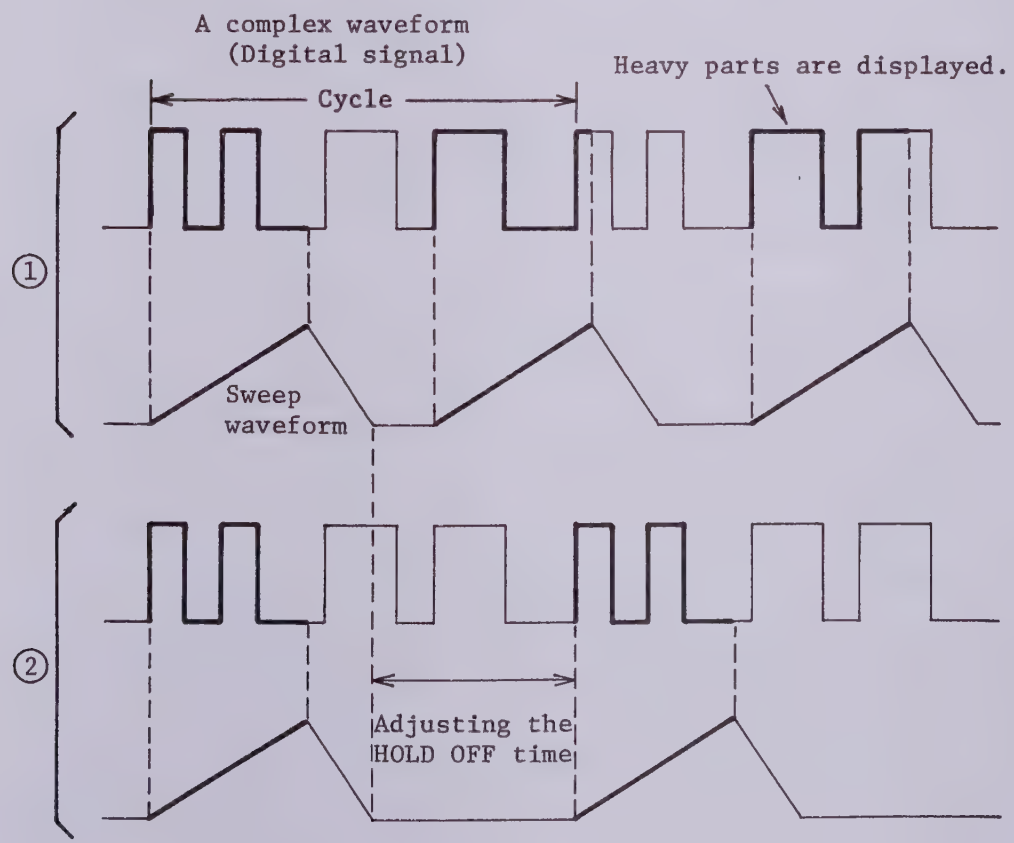



Figure 8

## 4.5 Single-sweep Operation

For photographic applications this mode is sometimes most preferable.

o Measurement of non-repetitive signal:

(1) Set the HORIZ DISPLAY in the "A" state and the SWEEP MODE in the NORM state.

(2) Applied the measured signal to the vertical input terminal and adjust the trigger level.

(3) Set the SWEEP MODE in the SINGLE state (the three push-button switches are pushed out).

(4) Depress the RESET button. The sweep will run for one cycle alone and the measured signal will be displayed only once for the corresponding period.

o Measurement of one-shot signal:

(1) Set the HORIZ DISPLAY in the "A" state and the SWEEP MODE in the NORM state.

(2) Apply the calibration output signal to the vertical input terminal, and adjust the trigger level at a value corresponding to the predicted amplitude of the measured signal.

(3) Set the SWEEP MODE in the SINGLE state. Apply the measured signal instead of the calibration signal to the vertical input terminal.

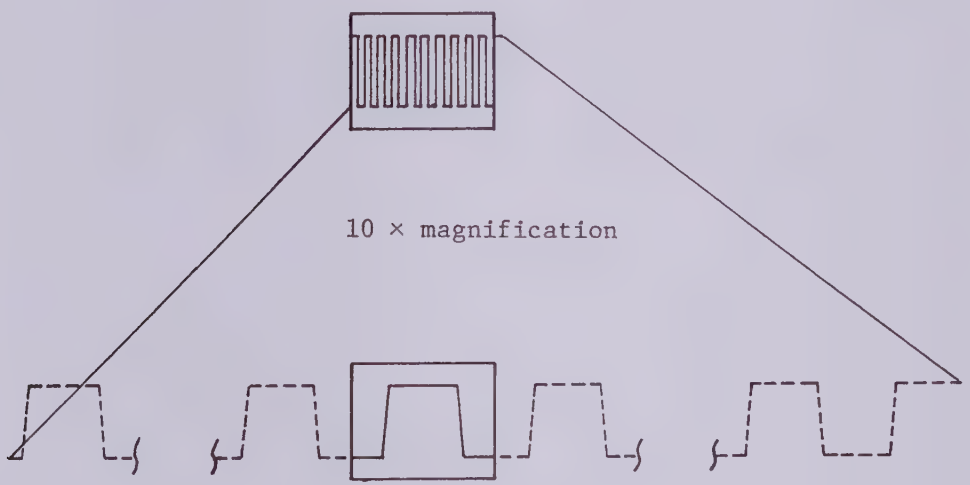
(4) Depress the RESET button. The sweep circuit will become the ready state and the READY lamp will turn on.

(5) As the one-shot signal occurs in the input circuit, the sweep runs for one cycle and the one-shot signal is displayed on the CRT screen.

The single-sweep operation can be done also with A INTEN and B sweep. However, it cannot be done in the ALT mode dual-channel operation. For dual-channel one-sweep operation, use the CHOP mode.

## 4.6 Sweep Magnification

When a certain part of the displayed waveform is required to be expanded timewise, a faster sweep speed may be used. However, if the required part is apart from the start point of the sweep, the required part may run off of the CRT screen. In such a case, set the "10 × MAG" switch (39) in the ▂ 10 × MAG state. When this is done, the displayed waveform is expanded by 10 times to right and left with the center of screen as the center of expansion.




Any part can be covered by means of POSITION control.

Figure 9

The sweep time when in the magnification operation is as follows:

(Value indicated by TIME/DIV switch) × 1/10

Thus, the maximum sweep speed (0.1 μsec/DIV) can be made faster with magnification as follows:

0.1 μsec/DIV × 1/10 = 10 nsec/DIV

When the sweep is magnified and the sweep speed has become faster than 0.1 μsec/DIV, the trace intensity may be reduced. In such a case, the displayed waveform should be expanded in the B sweep mode explained in the subsequent paragraphs.

## 4.7 Waveform Magnification with Delayed Sweep

With sweep magnification of the preceding paragraph, although the magnification method is simple, the magnification ratio is limited at 10. With the delayed sweep method of this paragraph, on the other hand, the sweep can be expanded for a wide range of from several times to several thousand times according to the ratio between A sweep time and B sweep time.

As the measured signal frequency becomes high and the A sweep range for the non-expanded signal becomes higher, the available expansion ratio becomes smaller. Further, as the magnification ratio becomes larger, the trace intensity becomes lower and the delay jitter increases. To cope with these situations, a triggered delay action circuit and a B ENDS A action circuit also are incorporated.

(1) Continuously-variably delay:

Set the HORIZ DISPLAY switch to A and display the signal waveform with the A sweep in the regular operation method.

Next, set the B TIME/DIV switch in a position faster by several steps than the A TIME/DIV switch.

After ensuring that the B TRIG'D switch is in the OFF state, turn the HORIZ DISPLAY switch to the A INTEN position. A part of the displayed waveform will be accentuated as shown in Figure 10. The part of the accentuated brightness denotes the section correspoding to the B sweep time (DELAYED SWEEP). This part is expand on the B sweep.

The period from the start of the A sweep to that of the B sweep (the period to that the trace is accentuated) is called "SWEEP DELAY TIME". This period is continuously variable by means of the DELAY TIME MULTI dial.

Next, change the HORIZ DISPLAY switch to the B position. The B sweep time will be expanded for the full span of the CRT screen as shown in Figure 11.

The B sweep time is set by the B TIME/DIV switch and the magnification ratio becomes as follows:

$$\text{Magnification ratio} = \frac{\text{A TIME/DIV indication}}{\text{B TIME/DIV indication}}$$

The sweep delay time can be read on the CRT screen. For more accurate determination, the DELAY TIME MULTI dial should be used.

$$\text{Sweep delay time} = \text{A TIME/DIV indication} \times \text{DELAY TIME MULTI dial setting}$$

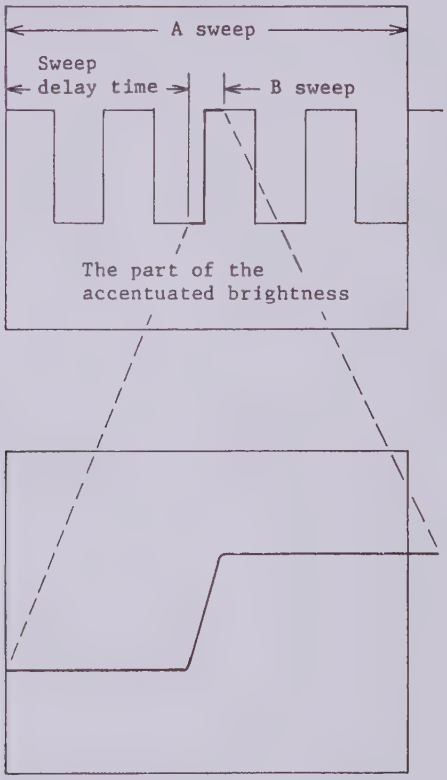



Figure 10

Figure 11

(2) Synchronized delay:

When the displayed waveform is magnified by 100 times or over in the above-mentioned continuous delay method, delay jitter is produced. To suppress the jitter, this synchronized delay method may be used.

With the synchronized delay, delay jitter is reduced by triggering the B sweep again after a sweep delay time as effected by the continuous delay method has elapsed.

For this operation, the B trigger circuit operates as the ▬ B TRIG'D (49) switch is set in the ▬ ON state and the B sweep is triggered by the B trigger pulse. Therefore, even when the delay time is continuously varied by rotating the DELAY TIME MULTI dial, the starting point does not vary continuously but varies intermittently. This operation in the A INTEN can be

observed as the accentuated section moves intermittently; however, the B sweep will appear to remain stationary.

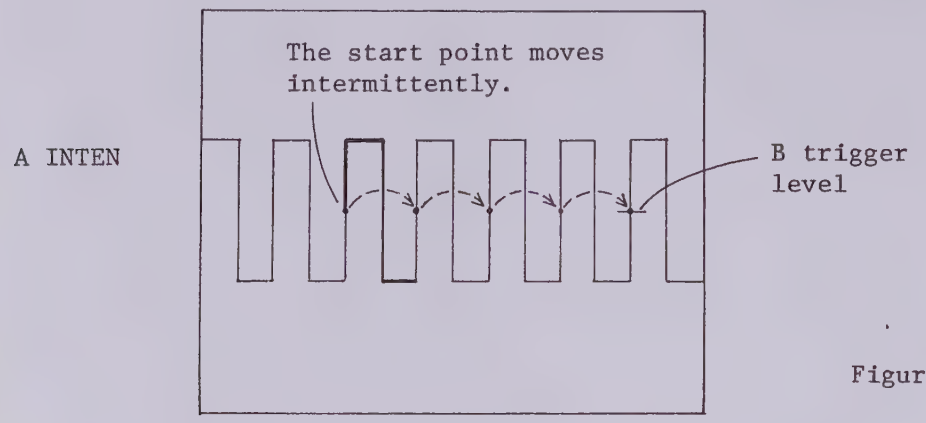



Figure 12

## 4.8 Delayed ALT Sweep

When in the Delayed ALT sweep mode, the A sweep and B sweep (delayed sweep) are displayed alternately on the screen, enabling you to observe at the same time the unmagnified waveform and magnified waveform of Section 4.7.

The operation method is the same as that of the delayed sweep of Section 4.7. As you turn the HORIZ DISPLAY switch to the ALT position, the A INTEN waveform and B waveform are displayed on the screen as shown in Figure 13. To prevent the two waveforms from overlapping and to display them separately, adjust the A, B TRACE SEPARATION potentiometer (34) .

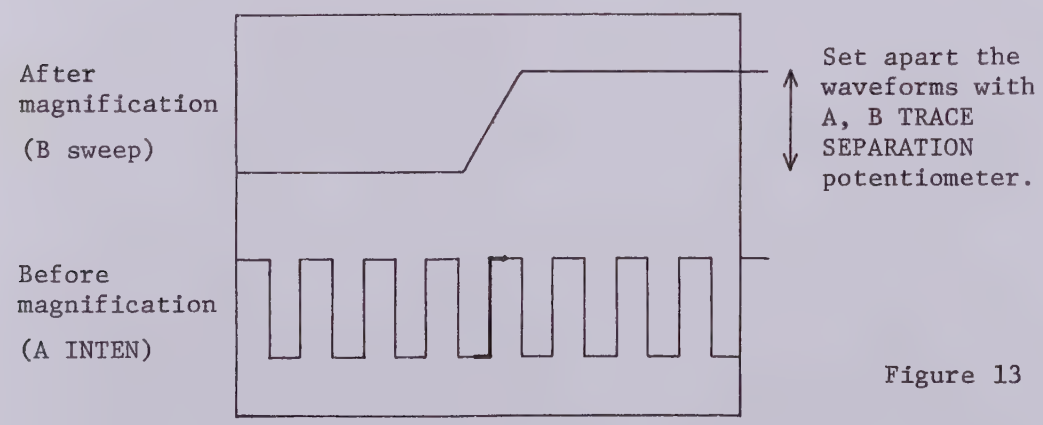

After magnification (B sweep)
Before magnification (A INTEN)
Set apart the waveforms with A, B TRACE SEPARATION potentiometer.

Figure 13

Note: The delayed ALT sweep mode can be used in combination with the dual-channel mode (CHOP or ALT) of the vertical axes.

## 4.9 B ENDS A Mode

When the trace is magnified by a large ratio with the delayed sweep, the magnified trace may become dim and hardly discernible. This is because, the slow A sweep runs for the full screen, before the B sweep can recieve A trigger signal. This causes most of the CRT beam current to be diverted to the A sweep display. By ending the A sweep at the minimum required point, the display time for the B sweep is increased so that the trace does not become dark. This is the B ENDS A mode.

The operating method is the same with that of Sections 4.8 and 4.9. Turn the A HOLD OFF knob (31) to the extreme clockwise position (B ENDS A position). A bright magnified trace as shown in Figure 14 will be displayed.

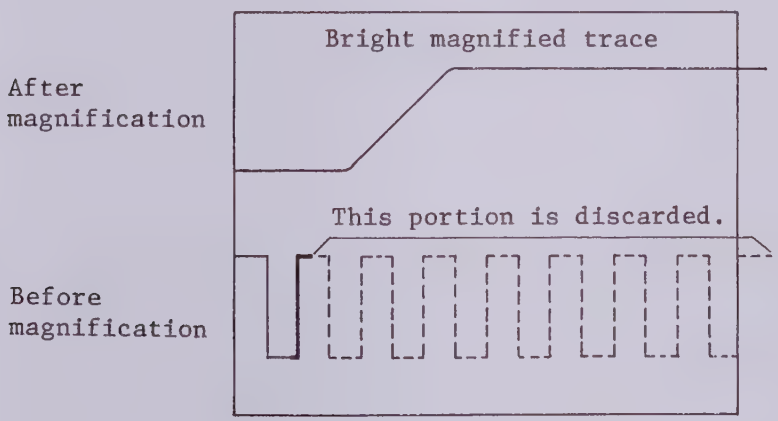



Figure 14

## 5.1 Connection Method of Input Signal

The input impedance of the oscilloscope as viewed from the vertical input terminal is 1 MΩ with capacitance approximately 20 pF in parallel. When the probe 10:1 is used, the impedance increases to resistance 10 MΩ with capacitance approximately 12 pF in parallel.

There are various methods of connection between measured signal source and oscilloscope. The most popular methods are with a probe, or with a coaxial cable. Suitable ones are used taking the following factors into consideration.

Output impedance of input signal source
Level and frequency of input signal
External induction
Distance between input signal source and oscilloscope

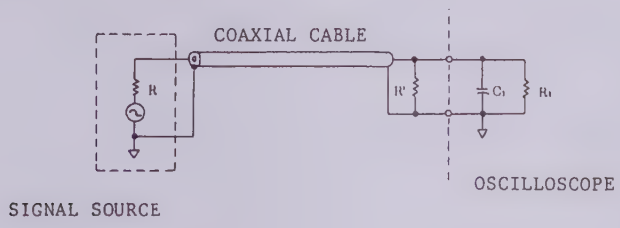
Types of input signals and connection methods are tabulated in the following:

| Type of input signal / Connection method | | | Probe | Coaxial cable |
|---|---|---|---|---|
| Low frequency | Low impedance | Near | ○ | ○ |
| | | Far | | ○ |
| | High impedance | Near | ○ | ▨ |
| | | Far | | ▨ |
| High frequency | Low impedance | Near | ○ | ○ |
| | | Far | | ○ |
| | High impedance | Near | ○ | ▨ |
| | | Far | | |

(○: Good, ▨: Fair)

o Connection with coaxial cable:

When the output impedance of the signal source is 50Ω or 75Ω, the input signal can be fed without attenuation up to high frequencies by using a coaxial cable which enables impedance matching. For impedance matching, terminate the coaxial cable with a 50Ω or 75Ω pure-resistive resistor corresponding to the characteristic impedance of the coaxial cable, as shown in Figure 15.




R = R'

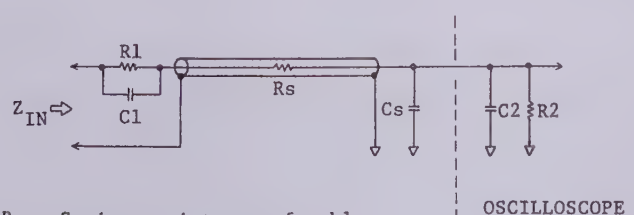
When R = 50 Ω, use a 50 Ω coaxial cable.

When R = 75 Ω, use a 75 Ω coaxial cable.

Figure 15

o Connection with probe:

A probe with an attenuation ratio of 10:1 is available as supplied. The probe circuit and probe cable are shielded to prevent induction noise. The probe circuit makes up a wide-range attenuator in conjunction with the input circuit of the oscilloscope, thereby enabling a distortionless connection from DC to high frequencies. When the probe is used, although the signal level is attenuated to 1/10, the input impedance becomes very high (resistance 10 MΩ, capacitance approx. 12 pF) and the loading effect on the measured signal source is greatly reduced as explained in the following.




Rs = Series resistance of cable

Cs = Stray capacitance plus cable capacitance

Figure 16

The probe makes up a wide-range attenuator with its resistor R1 which make up an attenuator circuit with respect to input resistor R2 of the oscilloscope and with its capacitor C1 which compensates for input capacitor C2 of the oscilloscope and stray capacitance (Cs) of the cable. The input impedance $Z_{IN}$ is expressed as follows:

$$Z_{IN} = \frac{R1 + R2}{C\ (R1 + R2) + 1}$$

$$C = \frac{C1 \times (C2 + Cs)}{C1 + C2 + Cs}$$

Attenuation ratio A is expressed as follows:

$$A = \frac{R2}{R1 + R2} \quad \left( = \frac{1\ M\Omega}{9\ M\Omega + 1\ M\Omega} = \frac{1}{10} \right)$$

The terms enclosed in the parentheses are for the factor when the probe is used:

Precautions:

- o Observe the maximum allowable input voltages mentioned in Section 3.4.
- o Do not fail to use the ground lead supplied.
- o Before commencing measurement, accurately adjust the frequency compensation of the probe without fail.
- o Do not apply unreasonably large mechanical shocks or vibration to the probe. Do not sharply bend or strongly pull the probe cable.
- o The probe unit and tip are not highly heat resistant. Do not apply a soldering iron to a circuit close to the point where the probe is left hooked up.
- o If a 1 × probe is used the bandwidth is severely limited due to the increased tip capacitance. This may load a circuit enough to significantly effect its operation.

## 5.2 Voltage Measurement

To measure an AC signal which has no DC component or to measure the AC component alone of a signal which has a DC componenet superimposed on the AC component, set the vertical input AC/DC selector switches (8) and (16) in the AC position. To measure the DC componenet of a signal, set the switch in the DC position.

Before commencing voltage measurement, set the VARIABLE attenuator knobs (6) and (14) at the CAL position and calibrate the sensitivity to the value indicated by the VOLTS/DIV selector switches (5) and (13).

Apply the signal to be measured, display the signal with an appropriate amplitude on the screen, and determine the amplitude on the graticule. (For DC voltage measurement, determine the shifted distance of the trace.) The voltage can be determined as follows:

(1) When measured signal is directly applied to input terminal:

Voltage (V) = Deflection amplitude (DIV) × Indication of VOLTS/DIV switch

(2) When the 10:1 probe is used:

Voltage (V) = Deflection amplitude (DIV) × Indication of VOLTS/DIV switch × 10

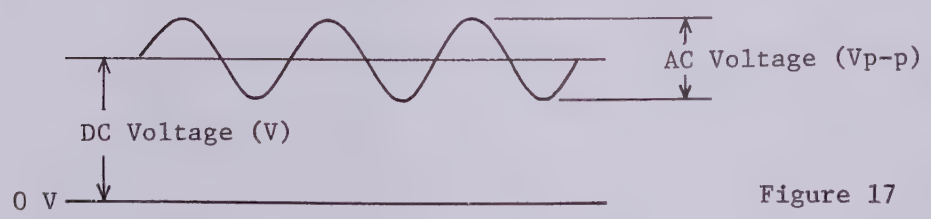



Figure 17

## 5.3 Current Measument (voltage drop method)

Connect a small resistor (R) in series in the circuit in which the current (I) to be measured flows and measure the voltage drop across the resistor with the oscilloscope. The current is known from Ohm's law as follows:

$$I = \frac{E}{R} \quad (A)$$

The resistance should be as small so that it does cause change to the measured signal source.

In the above method, currents from DC to high frequencies can be measured quite accurately. Note that the accuracy of the resistor reflectes upon the measuring accuracy.

## 5.4 Time Measurement

Measurement of time interval

The time interval between any two points on the displayed waveform can be measured by setting the TIME/DIV VARIABLE knob (44) in the CAL position and referring to the indication of the TIME/DIV switch (45).

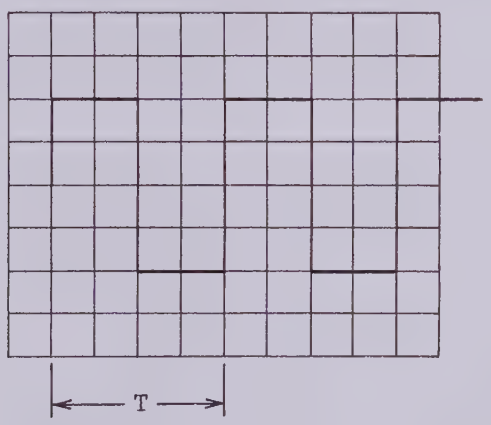



Figure 18

Time T (sec) = Indication of TIME DIV × Horizontal span (DIV)

When the sweep is magnified (10 × MAG (39)), the time is 1/10 of the value determined as above.

## 5.5 Frequency Measurement

- Frequency measurement by determining time (T) per one cycle of the displayed waveform:

  Time T (period) is measured as explained in section 5.4 and the frequency is known by using the following formula.

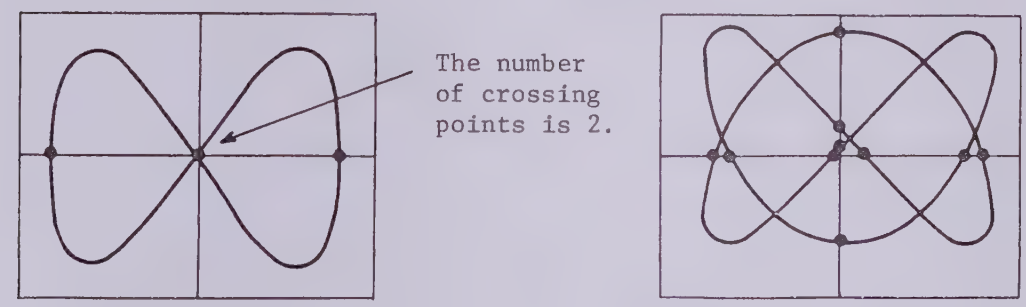
$$\text{Frequency } f \text{ (Hz)} = \frac{1}{\text{Period } T \text{ (sec)}}$$

- Frequency measurement with Lissajous figure (See Figures 19 and 20):

  Set the VERT MODE switch 1 in the X-Y state so that the oscilloscope operates in the X-Y mode.

Apply to the X-axis a known frequency from a signal generator (SG) and to the Y-axis the frequency to be measured. So adjust the required controls that a pattern is displayed on the full surface of the CRT screen. Then so adjust the frequency of the signal generator that the displayed pattern becomes stationary as shown in Figure 18. From the displayed waveform, the unknown frequency can be calculated as follws:

$$\text{Unknown Frequency (Hz)} = \frac{\text{The number of crossing points over horizontal scale line}}{\text{The number of crossing points over vertical scale line}} \times \text{Frequency of signal generator (Hz)}$$




$$\frac{4}{2} = \frac{2\ (H)}{1\ (V)} \qquad \frac{6}{4} = \frac{3\ (H)}{2\ (V)}$$

Figure 19

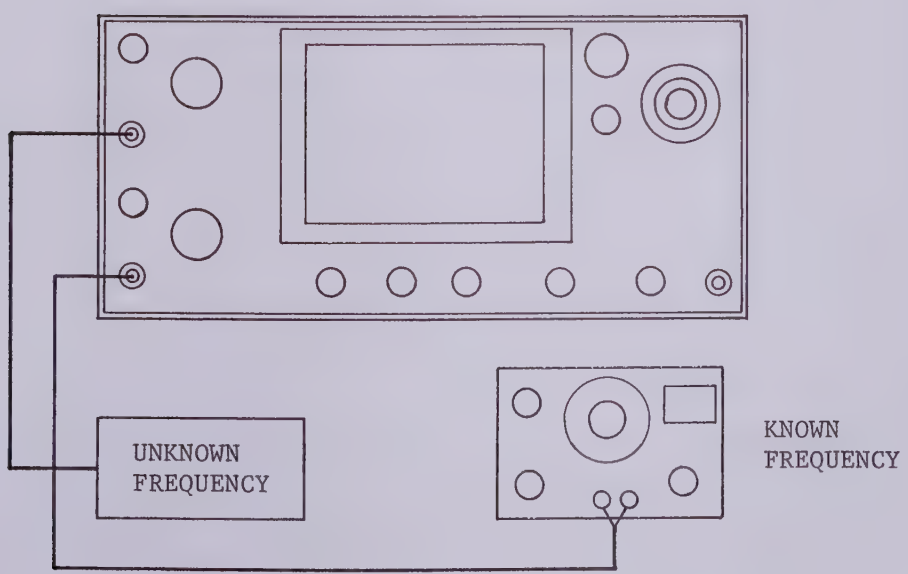



Figure 20

## 5.6 Measurement of Phase Difference

o Measurement of phase difference with Lissajous figure (See Figures 20, 21 and 22):

Operate the oscilloscope in the X-Y mode as explained in the paragraph for frequency measurement, and apply two signals of the same frequency (such as stereophonic signals) to the X and Y axes so that a Lissajous figure is displayed on the CRT screen. The phase difference between the two signals can be known by measuring the displayed waveform and employing the following equation:

$$\text{Phase difference } \theta = \sin^{-1} \frac{B}{A}$$

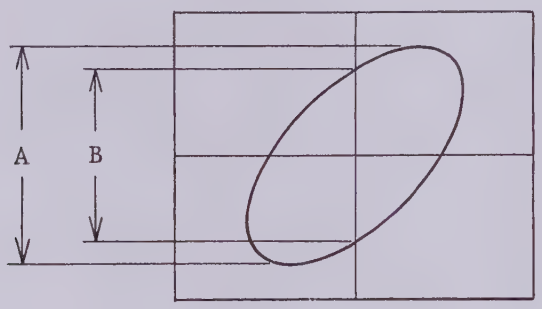



Figure 21

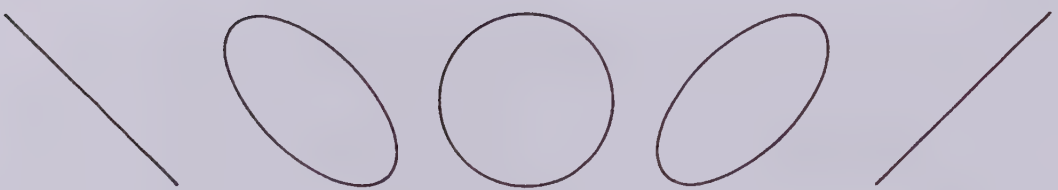



Figure 22

## 5.7 Characteristics of Pulse Waveform

A theoretically ideal pulse waveform is such that the signal changes instantaneously from one level to another, held in this level for a period of time and returns instantaneously to the original level. However, actual pulse waves are distorted. Nomenclature of distortions is given in Figure 23.

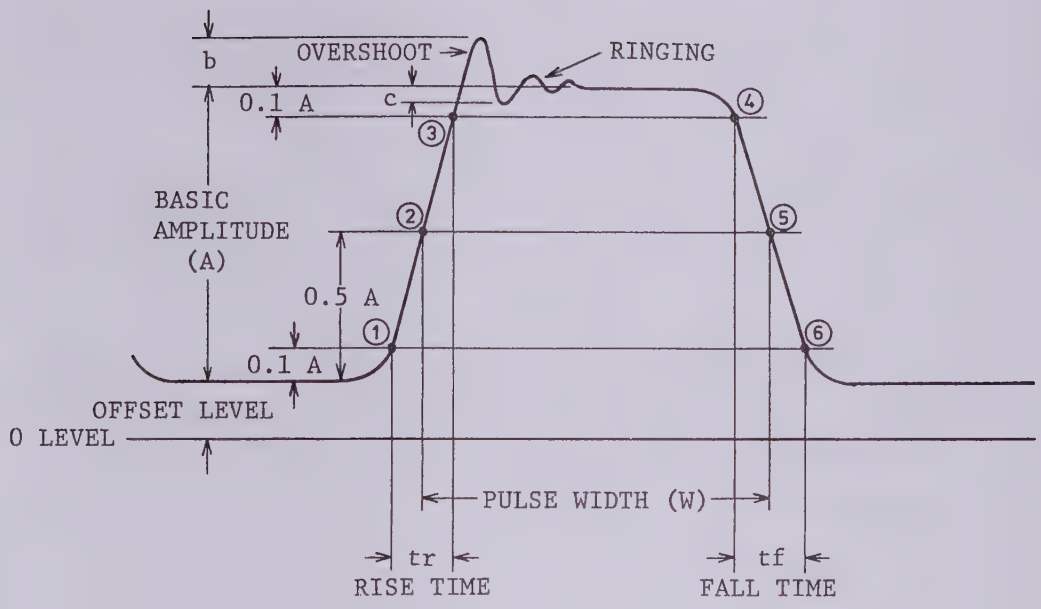



Figure 23

| | |
|---|---|
| Pulse amplitude: | Basic amplitude (A) of pulse |
| Pulse width: | Time between points ② and ⑤ where signal amplitude is 50% of basic amplitude |
| Rise time: | Time between 10% basic amplitude point ① and 90% basic amplitude point ③ |
| Fall time: | Time between 90% basic amplitude point ④ and 10% basic amplitude point ⑥ |
| Overshoot: | Amplitude of the first maximum excursion beyond basic amplitude. Expressed in terms of b/A × 100 (%) |
| Ringing: | Oscillation which follows the first maximum excursion. Expressed in terms of c/A × 100 (%) |

o Measurement of rise time:

The rise time of a pulse can be known by determining the value of $t_r$ on the CRT screen in the method of "Time Measurement." It must be noted that $t_r$ determined on the CRT screen includes the rise time of the oscilloscope itself. The closer the rise time of the oscilloscope ($t_o$) to the rise time of the measured

pulse ($t_n$), the larger is the error introduced. To eliminate this error, calculation should be done as follows:

$$\text{True rise time } t_n = \sqrt{(t_r)^2 - (t_o)^2}$$

where, $t_r$: Rise time measured on CRT screen

$t_o$: Rise time of oscilloscope itself (approx. 10 nsec)

For example, when a pulse wave with rise time 30 nsec (about 3 times of that of the oscilloscope) is measured on the CRT screen, the error is approximately 6%.

o Measurement of Sag

Pulse waveforms may have slanted sections as shown in Figure 24, other than those distortions mentioned in Figure 23. (For example, slants are caused when the signal is amplified with an amplifier which has poor low-frequency characteristics, resulting from attenuation of low frequency components.) The slanted section (d or d') is called "sag" which is calculated as follows:

$$\text{Sag} = \frac{d}{A} \text{ (or } \frac{d'}{A'}\text{)} \times 100 \text{ (\%)}$$

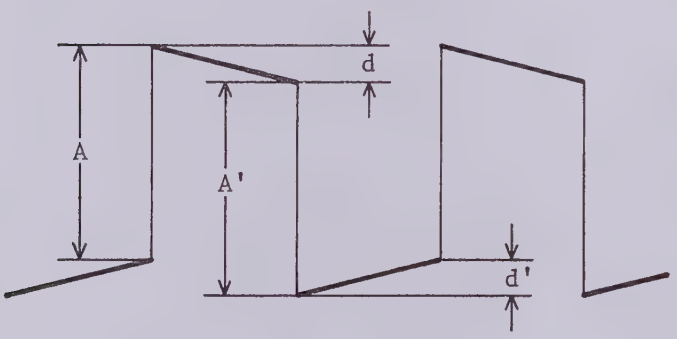



Figure 24

Note: If the AC-coupling mode is used for measurement of a low frequency pulse, sag is caused. For measurement of low frequency pulses, use always the DC-coupling mode.

## 6.1 General

The overall circuit structure of the 5650 is as depicted with a block diagram in Figure 25. It is comprised of a vertical deflection circuit for moving the beam spot in the Y-axis direction on the CRT screen, a horizontal deflection circuit for moving the beam spot in the X-axis direction, a CRT circuit for operating the cathode-ray tube, a calibrator circuit for calibrating the instrument probe, and a power supply circuit for supplying powers to the various circuits of the instrument.

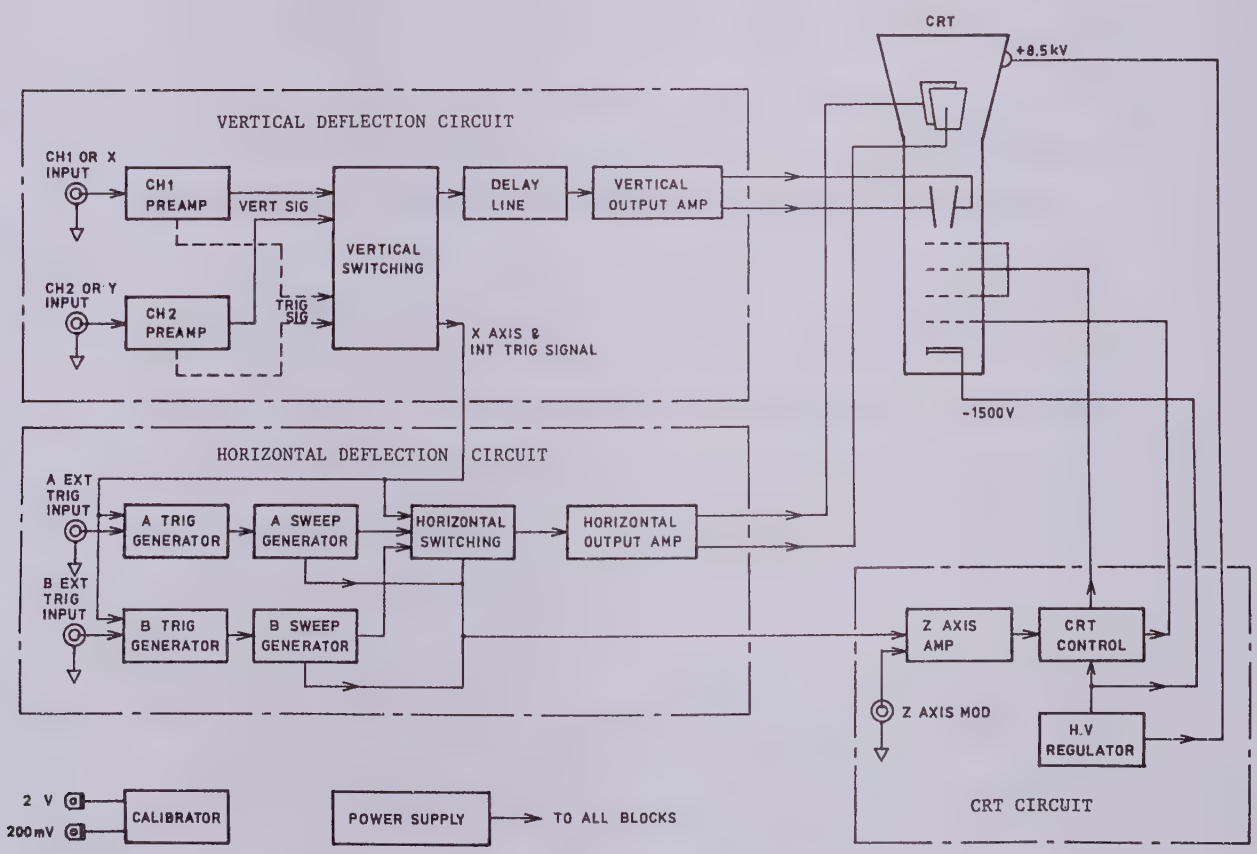



Figure 25

The vertical amplifier circuit has two mutually independent preamplifiers (CH1 and CH2), a vertical switching circuit, a delay line, and a vertical output amplifier.

Each of the preamplifiers amplifies or attenuates its input signal of several millivolts to several hundreds volts into a level suitable for handling by the subsequent stage. The conditioned vertical signals are sent to the vertical switching circuit. The trigger signals also are picked off at this stage.

The vertical switching circuit electronically switches the vertical signals sent from the CH1 and CH2 preamplifiers. The switched signal is fed via the delay line circuit to the vertical output amplifier. The trigger signals also are switched and fed as internal trigger signals to the A & B trigger generators or as X-axis signals to the horizontal switching circuit.

The vertical output amplifier amplifies the vertical signal, which is received through the delay line circuit, into a level of several volts to several tens volts for vertically deflecting the beam spot on the CRT screen.

The horizontal deflection circuit has mutually independent A and B trigger generators and sweep generators, a horizontal switching circuit, and a horizontal output amplifier.

The trigger generator receives the internal trigger signal from the vertical switching circuit or an external trigger signal from the EXT TRIG INPUT terminal and generates a trigger pulse signal.

The A sweep generator is driven by the trigger pulse signal of the A trigger generator and produces the A sawtooth signal. The sweep generator produces a sawtooth signal even when no trigger pulse is applied to it (the AUTO mode).

The B sweep generator produces the B sawtooth signal, being driven by the delayed sweep start signal produced with respect to the A sawtooth signal when in the delayed sweep mode. The B sweep generator can also be driven by the trigger pulse signal of the B trigger generator which follows the above delayed sweep start signal (the B TRIG'D mode).

The horizontal switching circuit electronically switches the sawtooth signals received from the A and B sweep generators and the X-axis signal received from the vertical switching circuit, and sends the resultant signal to the horizontal output amplifier.

The horizontal output amplifier amplifies the output signal of the horizontal switching circuit to a level of several volts to several tens volts in order to drive horizontally the beam spot on the CRT screen.

The CRT circuit is comprised of a high voltage generator (the HV regulator) to accelerate the electron beam emitted from the CRT cathode, a Z-axis amplifier to amplify the signal to blank out the return traces, and a CRT control circuit to operate the CRT tube in its optimal state.

The HV regulator provides a -1.5 kV voltage which is applied to the CRT cathode to accelerate the electrons emitted by it and a +8.5 kV voltage which is used as a post-acceleration voltage to accelerate further the electrons after passing the vertical and horizontal deflection plates.

The Z-axis amplifier amplifies the unblanking signals received from the A and B sweep generators and the trace intensity control signal to a level of several tens volts in order to be applied to the 1st grid (control grid) of the CRT via the CRT control circuit.

The CRT control circuit provides the various voltages for the CRT electrodes so that the CRT operates in an optimal state, displaying sharply-focussed less-distorted signal waveforms. It also conditions the signals received from the Z-axis amplifier and other circuit into levels suitable for application to the CRT.

## 6.2 CH1 and CH2 Preamplifiers

The CH1 and CH2 preamplifiers amplify the signals of the CH1 (X-axis) input and CH2 (Y-axis) terminals, respectively. A block diagram of these preamplifiers are shown in Figure 26.

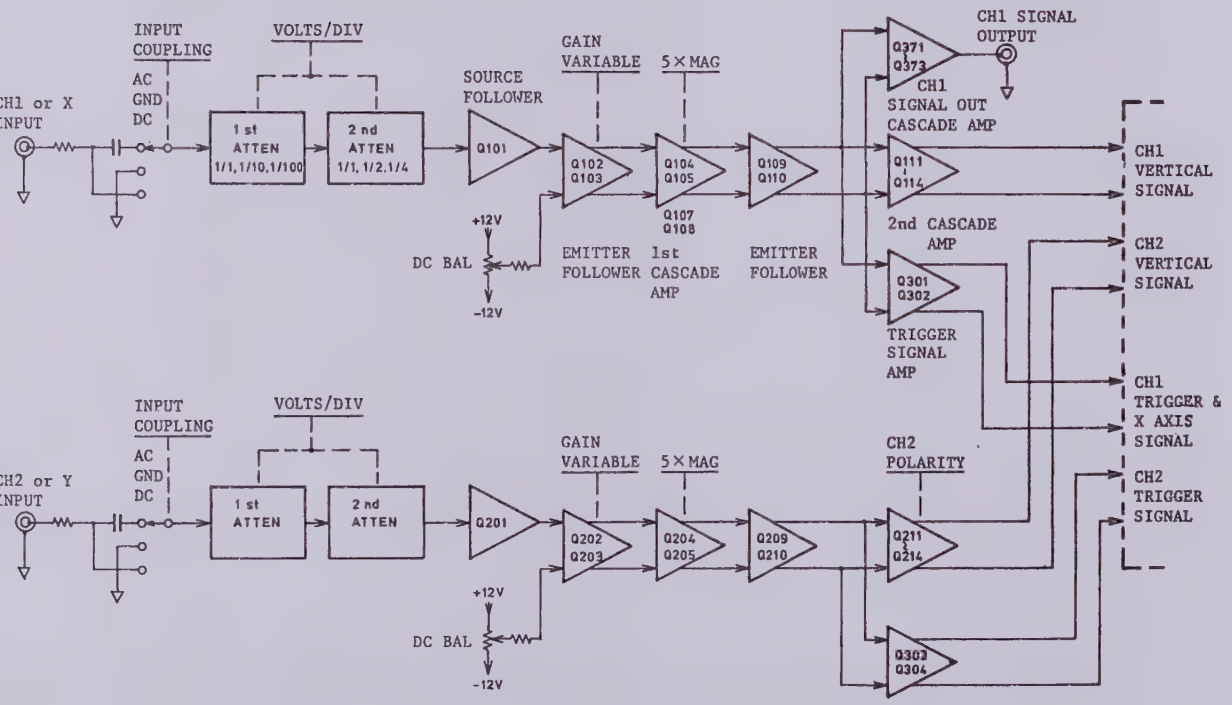



Figure 26

o Input coupling switch:

The input coupling switch (SW101/201) selects the input coupling mode for AC, GND, or DC. When the GND state is selected, the preamplifier input is isolated from the input terminal and is grounded so that the base line (0 level) on the CRT screen can be checked.

o Attenuators:

The attenuator circuit consists of two attenuators: the 1st attenuator for 1/1, 1/10 and 1/100, and the 2nd attenuator for 1/1, 1/2, 1/4 and 1/10. By combinations of these attenuators with the VOLTS/DIV switch (SW102/202), the signal can be attenuated for a total range of 1/1 to 1/1000 in 10 steps. The attenuator circuit is so designed that its input impedance remains constant at 1 MΩ, 20 pF (±2 pF) even when combinations are changed.

o Impedance converter:

The impedance converter presents with its source follower (Q101/201) a high input impedance to prevent the loading effect on the high-impedance attenuator circuit and provides a low output impedance with its emitter follower (Q102, 103/202, 203) to drive the 1st differential cascade amplifier of the next stage. In order to guard against thermal drift, the source follower employs a dual-FET package which houses two thermally-coupled elements for thermal drift compensation and the emitter follower employs two premium-grade thermally-coupled transistors.

o 1st differential cascade amplifier:

The 1st differential cascade amplifier is comprised of an emitter-connected differential current amplifier (Q104, 105/204, 205) and a current-to-voltage converter (Q107, 108/207, 208) which converts the differential collector output current of the differential

current amplifier into a voltage signal. This amplifier also has the VARIABLE circuit for continuously-variable adjustment of the sensitivity between two adjoining vertical deflection sensitivity ranges selected by the VOLTS/DIV switch and the 5 × MAG switch for magnifying the vertical sensitivity by 5 times to realize the 1 mV/DIV sensitivity.

o VARIABLE circuit:

The VARIABLE circuit continuously-variably adjusts the vertical sensitivity by shunting with potentiometer R128/228 a part of the collector current amplified by Q104, 105/204, 205. Adjustment (attenuation) can be done with a ratio of 1/2.5 or over.

o 5 × MAG circuit:

The 5 × MAG function is to increase the vertical sensitivity by 5 times by switching the output load resistor of the 1st differential cascade amplifier to the value of 5 times of that when in the normal mode, with the diode switching circuit (CR102 - 105/202 - 205). The diode switching circuit is DC-controlled by the 5 × MAG switch (S302/304).

o Buffer emitter follower:

The buffer (Q109, 110/209, 210) has a function of sending, with less loading effects, the output signal of the preceding 1st differential cascade amplifier to the subsequent 2nd differential cascade amplifier, trigger signal pickoff amplifier, and CH1 SIGNAL OUTPUT amplifier (CH1 only).

o 2nd differential cascade amplifier:

The 2nd differential cascade amplifier (Q111 - 114/Q211 - 216) amplifies the output of the emitter follower to a sufficient level for driving the vertical switching circuit. The grounded-base stage (Q113, 114/213, 214) of this cascade amplifier has a

function of preventing the switching signal of the vertical switching circuit from being returned to the preceding stage and mixed into the trigger signal or the signal of the CH1 SIGNAL OUTPUT amplifier. For the CH2 signal, this amplifier also has a function of inverting its polarity. This polarity switching function is accomplished by mutually corssing the amplified collector currents of Q211 and Q212 and switching by the POLARITY switch (S305) the grounded-base stage circuits of Q213, 216 and Q214, 215 the collectors of which are connected to the collectors of Q211 and Q212.

Different from the case of the 1st differential cascade amplifier, the output signal of the 2nd differential cascade amplifier is fed directly in the form of the current signal to the diode gate of the vertical switching circuit. The current signal for vertical positioning of the trace on the CRT screen is added to the output current signal of the 2nd differential cascade amplifier, being controlled by potentiometer R176/276 of the positioning circuit.

o CH1 SIGNAL OUTPUT amplifier (CH1 only):

The CH1 SIGNAL OUTPUT amplifier ( Q371, Q372, Q373 ) amplifies the input signal of the CH1 (X INPUT) terminal by approximately 5 times (2.5 times when terminated with 50 ohms). The amplified signal is fed to the output terminal ( J-86 ) on the instrument rear panel in order to be monitored with a frequency counter or other measuring instrument.

## 6.3 Vertical Switching Circuit

The vertical switching circuit is comprised of a vertical signal switching circuit which electronically switches the CH1 and CH2 vertical preamplifier output signals, an internal trigger signal

switching circuit which electronically switches the trigger signals, and a switching logic circuit which controls the above switching circuits.

The vertical signal switching circuit is, as shown in Figure 27, comprised of a diode gate circuit, an ADD BAL and buffer circuit which switches the vertical signals with the signal received from the switching logic circuit, and a delay line driver which receives the signal from the diode gate and drives the delay line circuit.

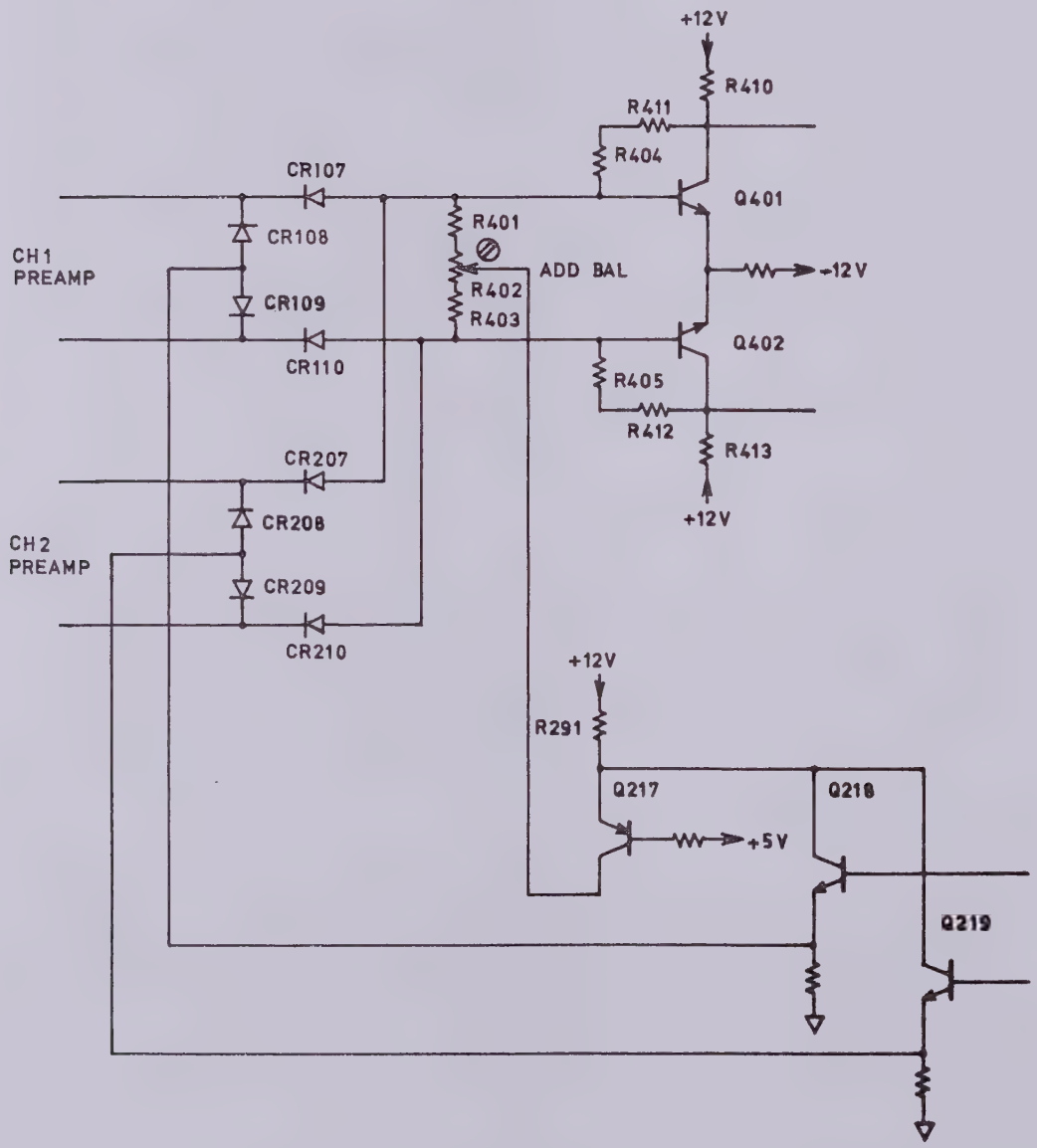



Figure 27

o Diode gate

The diode gate (CR107 - 110/207 - 210) selects the CH1 or CH2 signal or both CH1 and CH2 signals (when in the ADD mode) with the output signal of the switching logic circuit in conformity with the signal selected by the VERT MODE switch (S303).

For example, when the CH1 mode is selected by the VERT MODE switch, the base of Q218 becomes the low state and CR108 and CR109 are cut off. The base of Q219 becomes the high state, a current flows in CR208 and CR209 through R291 from the +12V supply, and CR207 and CR210 are cut off. The current which flows in the negative feedback resistors (R404, 411/405, 412) of the delay line driver circuit is fet to the CH1 preamplifier through CR107 and CR110, and the delay line driver circuit delivers the signal of the CH1 preamplifier.

o ADD BAL circuit:

When the ADD mode is selected by the VERT MODE selector, the bases of Q218 and Q219 become the low state and the signals of the CH1 and CH2 preamplifiers are fed via CR107, 110/CR207, 210 to the delay line driver circuit and the sum of the two signals appears at the output circuit. Disturbance of DC balance which may be caused in this case is compensated for by semi-fixed potentiometer R402 of the DC BAL circuit.

o Delay line driver circuit:

For the delay line driver circuit (Q401, 402), a negative feedback type low input impedance circuit is used from the viewpoint of connecting the diode gate circuit. This circuit has an amplitude limiting function to prevent abnormally large amplitude applied to the vertical output amplifier. By resistors R414 and R415, the impedance of the output circuit is matched with that of the delay line circuit.

o Internal trigger switching circuit:

The internal trigger switching circuit directly controls, with the control signal from the switching logic circuit, the diode gate (CR301 - 304/305 - 308) which is similar to the vertical signal switching circuit. It receives with its grounded-base switching buffer (Q305, 306) the trigger signal which has passed the diode gate circuit and feeds the signal to the balanced/non-balanced amplifier. The balanced/non-balanced amplifier (Q307, 308) converts the balanced output signal of the switching circuit into a non-balanced signal (a single-ended signal) which is delivered as the X-axis signal or the internal trigger signal via connector P-23.

o Vertical switching logic circuit:

The vertical switching logic circuit is comprised of two edged trigger type flip-flops (IC U303) with a preset/clear function, as shown in Figure 28.

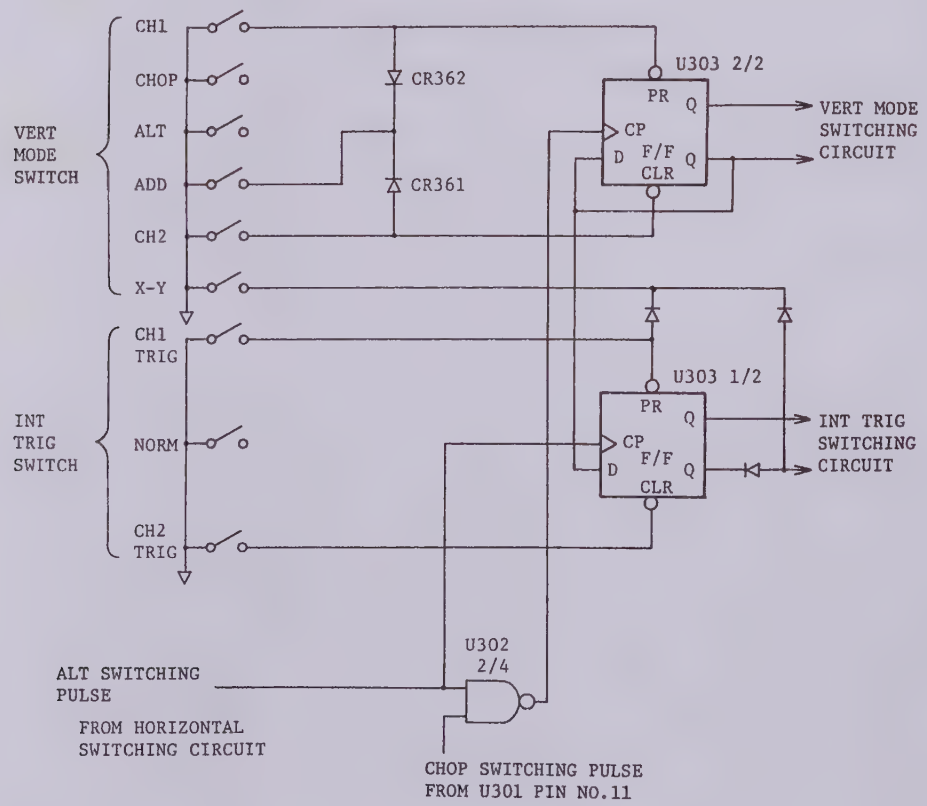



Figure 28

The flip-flop of V303-2/2 controls the vertical signal switching circuit to the mode selected by the VERT MODE switch. The flip-flop of V303-1/2 so controls the internal trigger switching circuit that the trigger signal as selected by the INT TRIG switch is obtained. When the NORM mode is selected by the INT TRIG switch, the output (Q) of the flip-flop of V302-2/2 is fed to the D terminal of the flip-flop of V302-1/2 so that an internal trigger signal conforming with the setting of the VERT MODE switch is obtained. This relationship is shown in the following table:

| VERT MODE / INT TRIG MODE | CH1 | CH2 | CHOP | ALT | ADD | X-Y |
|---|---|---|---|---|---|---|
| CH1 | CH1 (▽ provides trigger signal of pre-amplifier.) | | | | | - |
| CH2 | CH2 (▽ provides trigger signal of pre-amplifier.) | | | | | - |
| NORM | CH1 ( ▽ ) | CH2 ( ▽ ) | - | *Alternate outputs | CH1 ( ▽ ) | - |

* To sweep the CH1 channel when in the ALT mode, the CH1 trigger signal is delivered; to sweep the CH2 channel, the CH2 trigger signal is delivered.

## 6.4 Delay Line

The output signal of the vertical switching circuit is fed to the delay line (DL501). The delay line is a special type of cable which provides a delay time of approximately 120 nsec. This delay time is required in order to cope with the signal delay which may be caused in the horizontal deflection circuit, Z-axis amplifier, and other circuits and which may make the starting portion of the signal lost from being displayed on the CRT screen. The output signal of the delay line is fed to the vertical output amplifier.

## 6.5 Vertical Output Amplifier

The vertical output amplifier is comprised of a delay line receiver which receives the output signal of the delay line with a matched impedance, an A & B trace separation circuit which positions the B sweep waveform when in the ALT mode, an emitter follower circuit which converts the output of the delay line receiver into a sufficiently low impedance to drive the final cascade amplifier which drives the vertical deflection plates of the CRT, and an X-Y alignment circuit which adjusts the right-angle feature of the displayed axes. A schematic diagram of the vertical output amplifier is shown in Figure 29.

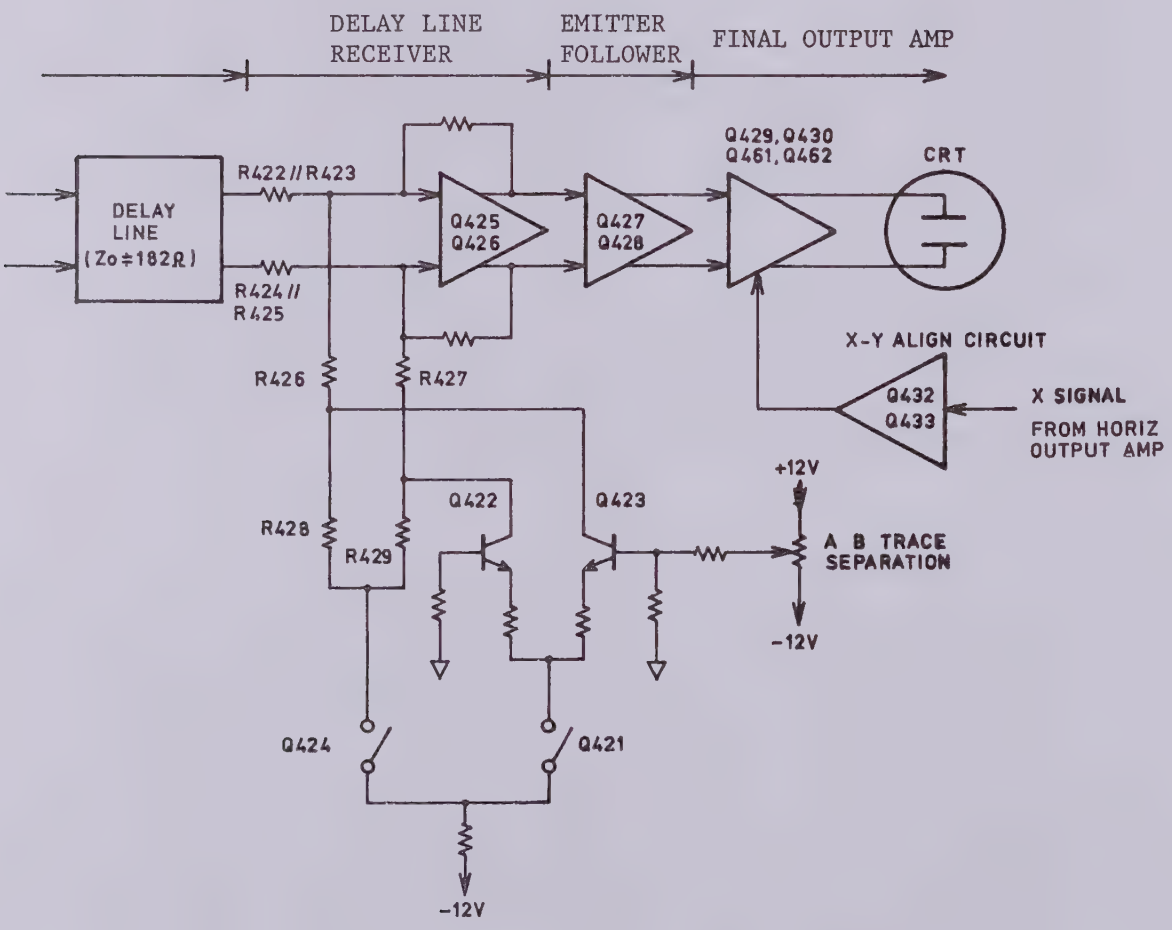



Figure 29

o Delay line receiver circuit:

The delay line receiver circuit (Q425, 426) is a low input impedance negative feedback amplifier which, with its input resistors R422/R423, R424/R425, provides impedance matching with the characteristic impedance (Zo ≒ 182 ohms) of the delay line. With this low input impedance, the A & B trace separation circuit is connected in parallel.

o A & B trace separation circuit:

The A & B trace separation circuit vertically positions the trace by varying the currents which flow through resistors R426 and R427 from the input of the delay line receiver, as shown in Figure 29. In order to prevent intrusion of switching pulses, this circuit has a balanced current circuit (R428 and R429) and an unbalanced current circuit (Q422 and Q423), and these circuits are switched by the transistor switching circuit (Q424, 421). Balancing of the currents which flow in Q422 and Q423 is adjustable with the A & B TRACE SEPARATION potentiometer (R1003).

o Emitter follower:

The emitter follower (Q427, 428) converts the output signal of the delay line receiver into a low impedance to drive the final cascade amplifier. In order to suppress parasitic oscillations, the signal is fed from the emitters of Q427 and Q428 to the bases of Q429 and Q430 through R442 and R445.

o Final cascade amplifier:

The final cascade amplifier is a differential cascade amplifier comprising of a current amplification stage (Q429, 430) which has a high $f_T$ in order to provide a sufficient output voltage to drive the vertical deflection plates of the CRT, and a voltage converter stage (Q481, 482) which employs high-voltage-type high-frequency transistors.

The right-angle compensation current signal of the X-Y alignment circuit is added to the output of the above current amplifier in order to maintain the perpendicularity of the axes on the CRT screen.

o X-Y alignment circuit:

The X-Y alignment circuit (Q432, 433) is a differential amplifier which provides a current signal to compensate for right-angle error of the axes on the CRT screen. This amplifier receives part of the horizontal deflection signal from the horizontal output amplifier and converts it into a perpendicularity compensation current signal, which is applied to the emitters of Q481 and Q482. The polarity and amount of the perpendicularity compensation current signal are adjustable with the X-Y ALIGN potentiometer (R469).

## 6.6 A and B Trigger Generators

The A trigger generator is comprised of a trigger pulse generator circuit which produces a trigger pulse signal for driving the A (main) sweep generator and an AUTO circuit which produces a free-run signal for automatic sweep operation when the trigger signal is asynchronized or no trigger signal is applied. The B trigger generator produces a trigger pulse for driving the B (delayed) sweep generator when in the B TRIG'D mode.

A Trigger Generator:

As shown in Figure 30, the trigger pulse generator circuit of the A trigger generator is comprised of a source switch which selects a trigger signal source, a coupling switch which selects a coupling mode in conformity with the nature of the trigger signal source, an impedance converter circuit which converts the high-impedance trigger source signal into a low-impedance signal with which to drive the level comparator circuit which controls the start point (triggered point) of the signal waveform displayed on the CRT

screen, a TV synchronization separator circuit which picks off the synchronization signal from the TV video signal, and Schmitt trigger circuits which convert the output signals of the level comparator circuit and TV synchronization signal separator circuit into TTL level signals.

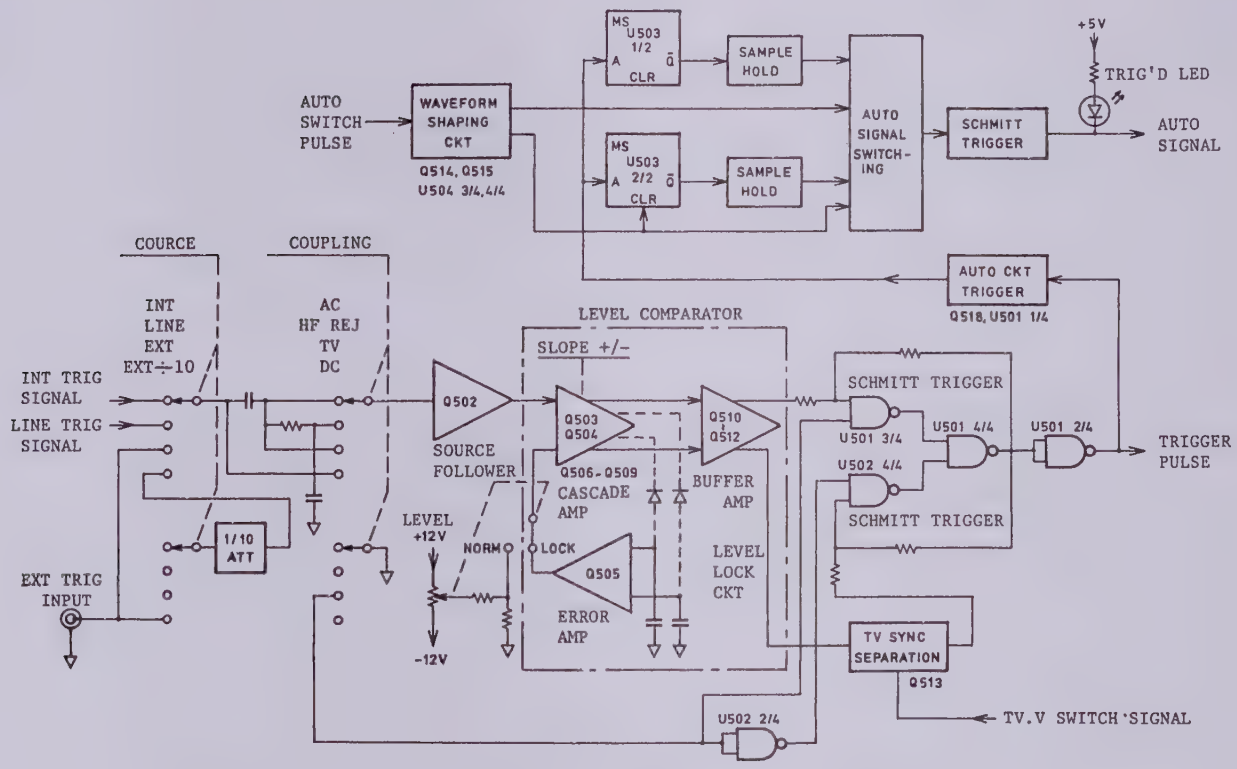



Figure 30

o Source switch:

The source switch (S501) selects the internal trigger signal received by Q501, the external trigger signal fed from J-4, or the signal fed from J-4, which has been attenuated by a factor of 1/10 into the EXT ÷ TRIG signal. The selected signal is fed to the coupling switch.

o Coupling switch:

The coupling switch (S502) selects the coupling mode. Switch S502-1 selects the DC mode for direct coupling of the signal fed from S501, the AC mode for discarding the DC component, or the HF REJ mode for coupling via a low-pass filter. Switch S502-2 selects ON or OFF of the TV synchronization signal separator circuit which facilitates observation of a TV video signal.

o Impedance converter:

The impedance converter is a temperature-compensated-type cathode follower (Q502) with dual FETs. It converts the trigger signal selected by the source switch and coupling switch into a low-impedance signal with which to drive the level comparator circuit.

o Level comparator:

The level comparator is a differential cascade amplifier (Q503, 504, 506 - 509) which adjusts the rise up portion (or the fall down portion) of the comparator output signal, by applying to the base of Q503 of the current amplifier stage the trigger source signal from the impedance converter circuit and adding to the base of Q504 the comparator level signal from the LEVEL control potentiometer (R511). In this case, if switch S503 which is linked to the LEVEL control potentiometer is locked, the comparator level signal is applied to the base of Q504 from the level lock circuit and the trigger point is fixed at the center amplitude of the

trigger source signal. The level lock circuit amplifies with its error amplifier the error signal detected by CR526 and CR527, and feeds back the signal so that the center level of the comparator output signal becomes the Schmitt level of the Schmitt trigger circuit.

The SLOPE switch (S504) selects a slope by switching between Q506, Q509 and Q507, Q508 of the voltage converter stage of the cascade amplifier.

The output signal of the cascade amplifier is amplified further by the feedback-type differential amplifier (Q510, 511, 512) and the amplified signal is fed to the TV synchronization signal separator circuit and the regular (non-TV) Schmitt circuits.

o TV synchronization signal separator circuit:

The TV synchronization signal separator circuit (Q513) is a base leak type circuit and picks off the synchronization signal from a video signal. When in the TV.H synchronization mode, the output signal is directly fed to the Schmitt trigger circuit. When in the TV.H synchronization mode, the circuit produces a TV.V synchronization signal by grounding with V502 3/4 IC the capacitor (C532) which is connected so that the input resistance of the Schmitt trigger circuit becomes the integration resistance of the integration circuit. Switching between TV.V and TV.H is done being linked to the TIME/DIV switch within the following ranges:

TV.V: 0.5 sec - 0.1 msec ranges
TV.H: 50 µsec - 0.1 µsec ranges

o Schmitt trigger circuits:

One of the Schmitt trigger circuits is for the normal mode and is comprised of gate circuits of U501 3/4 and U501 4/4, and the other for the TV mode and is comprised of gate circuits of U502 4/4 and

U501 4/4. Selection between these two circuits is done by turning on the gate circuit of U501 3/4 or that of U502 4/4 with the COUPLING switch (S502-2). The output signal of either Schmitt trigger circuit is inverted by the gate circuit of U501 2/4 and drives the A sweep generator and the AUTO circuit.

o AUTO circuit:

The AUTO circuit converts with its pulse converter (Q518, U501 1/4) the high-speed pulse signal of the trigger pulse generator into the low-speed pulse signal which is applied to the CH1 and CH2 monostable multivibrators (U503 1/2, 2/2) to generate the CH1 and CH2 AUTO signals. With its AUTO switching pulse shaping circuit (Q514, 515, U504 3/4, 4/4), it receives the AUTO switching pulse signal from the vertical switching circuit and generate the CH1 and CH2 AUTO switching pulse signal. This switching signal is applied to the AUTO signal switching circuit (CR534 - 537, Q516, 517) to switch the CH1 and CH2 AUTO signals. The switched AUTO signal is conditioned for waveform-shaping by the Schmitt circuit (V504 1/4, 2/4) to drive the A sweep generator and the TRIG'D LED lamp.

B Trigger Generator

The B trigger generator is identical with the A trigger generator except that the former has no AUTO circuit as no such circuit is required for its operation. It employs a diode gate circuit for trigger source selection. It employs a simpler level lock circuit as it requires AC-coupling only.

## 6.7 A and B Sweep Generators

The A sweep generator produces the sawtooth signal for the main sweep (A sweep) of this oscilloscope. The B sweep generator produces the sawtooth signal for magnification in the time axis direction the waveform displayed on the main sweep or for display with

a certain time delay (delayed sweep or B sweep).

The A sweep generator consists of the A sweep gate circuit which receives the trigger signal from the A trigger generator and produces the sweep gate signal for starting sweeps, the sweep start comparator which maintains stably the sweep start point, the A sawtooth sweep generator which produces a sawtooth wave in conformity with the time constant selected by the TIME/DIV switch, the sweep length circuit which controls the length of sweeps, the hold off circuit which controls the sweep return period and pause period, and the A sweep gate enable circuit which controls the sweep gate circuit in conformity with the AUTO, NORM or SINGLE mode as selected by the MODE switch for the signals of the above control circuits.

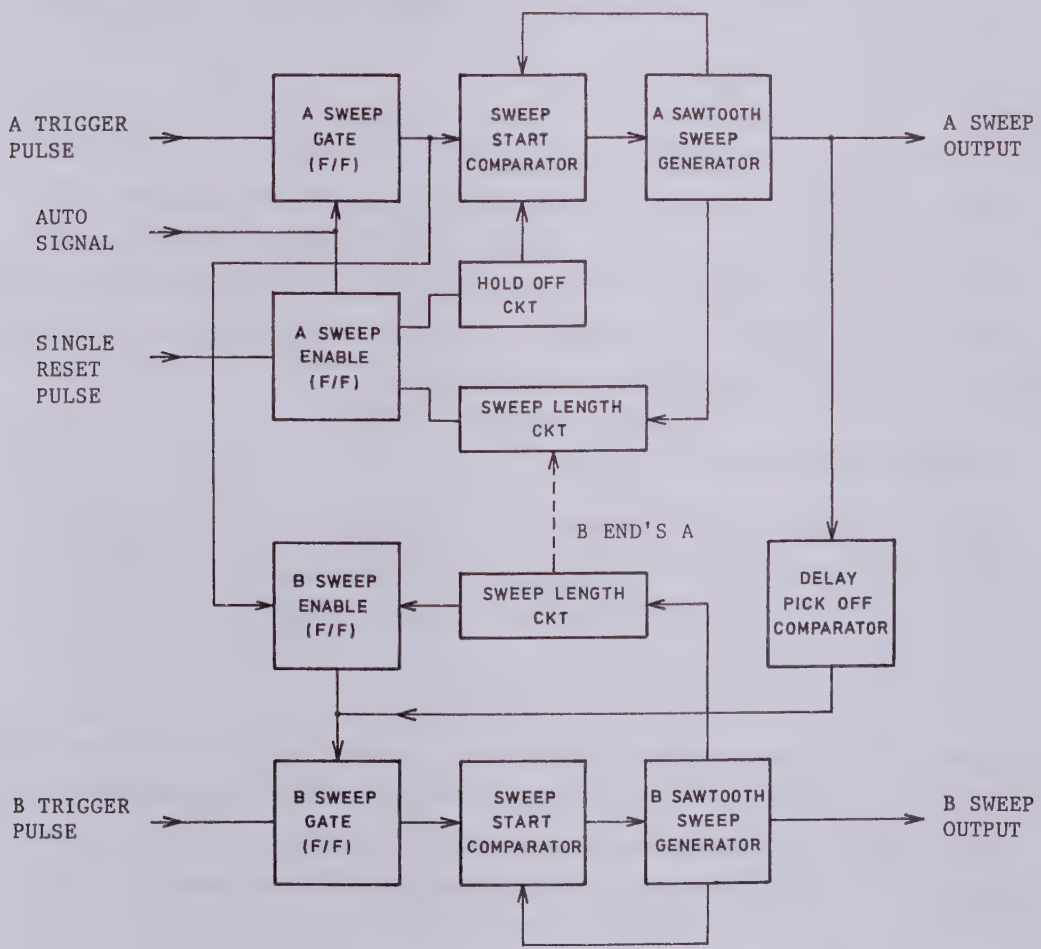



Figure 31

o A sweep gate:

The A sweep gate circuit employs a flip-flop TTL IC (Schottkey type) with RESET/CLEAR function. The trigger pulse of the A trigger generator is applied to the CLOCK (No.1) terminal, the enable signal of the A sweep gate enable circuit to the CLEAR (No.15) terminal, and the enable signal and AUTO signal of the AUTO circuit to the RESET (No.4) terminal through the NAND gate circuit. The Q (No.5) terminal output is applied as the unblanking signal to the Z-axis amplifier and the $\overline{Q}$ (No.6) terminal output is fed to the sweep start comparator circuit and becomes the A sweep gate signal. Even when no trigger pulse signal is applied to the CLOCK terminal, the $\overline{Q}$ output can be made the low state with the AUTO signal of the PRESET terminal so that the A sweep gate signal is generated and the circuit operates in the free-run mode.

o Sweep start comparator:

The sweep start comparator (Q701, 702) is a differential amplifier which lets the sweep gate signal pass and maintains constant the sweep start level. A start reference level identical with the B sweep start level is applied to one of the inputs, the Miller integrator output signal is applied to the other input, and the difference between the two signals is compensated for.

o A sawtooth generator:

The A sweep generator is comprised of a gate transistor amplifier, a Miller integrator, an integration time constant switching circuit, and a logic circuit which controls the switching circuit. The gate transistor amplifier (Q801) controls the Miller integrator circuit in such manner that the start level control signal and sweep gate signal of the sweep start comparator do not affect the integration time constant. The Miller integrator (Q804 - Q806) produces a sawtooth signal with the time constant selected by the integration time constant selector circuit. The integration time constant selector circuit

selects integration capacitor C804/C805 with Q802/Q803 and integration resistors R808 - 816 with CR802 - CR810. The logic circuit selects an integration capacitor and a resistor in conformity with the range selected by the TIME/DIV switch (S801) in order to control the integration time constant selector circuit.

o Sweep length circuit:

The sweep length circuit (Q703, U703 1/4, 2/4, 3/4) divides with its voltage divider (R724, R725, R726) the output of the A sweep generator, converts the impedance with its emitter follower (Q703), shapes the waveform with its Schmitt circuit (U703 1/4, 2/4), and inverts the signal with its inverter (U703 3/4) to produce the length signal. The B END A signal is added to the signal of No.5 pin of U703 2/4.

o Holdoff circuit:

The holdoff circuit generates a holdoff (pause) time signal proportional to the sweep time by producing a triangular wave with the Miller integrator (Q705) and making use of the fall time of the triangular wave. The integrator, with its Q711 and Q712, selects the time constant in accordance with the integration output voltage in order to cover a wide time range. The output signal of the Miller integrator is detected by Q704 and shaped by the Schmitt circuit (U702 1/4, 2/4) into a holdoff signal. The trigger pulse is fed to the input circuit of the Schmitt circuit via R730 and C702 in order to suppress jitter which could be produced when in high speed sweep.

o A sweep gate enable circuit:

The A sweep gate enable circuit employs the flip-flop IC (U701 2/2) which makes up a pair with the A sweep gate circuit. The holdoff signal is applied to the RESET (No.10) terminal, the length signal

is applied to the CLEAR (No.14) terminal, and the enable signal is delivered from the Q (No.9) terminal. This enable signal clears or sets the A sweep gate circuit. When in the NORM sweep mode, the output signal of the AUTO circuit is blocked and, if no trigger signal is applied, the circuit is in the ready state. When in the SINGLE sweep mode, the holdoff circuit remains idle, the J (No.11) terminal is set in the high state, and a one-shot sweep is effected by the reset signal applied from the CLOCK (no.13) terminal.

The basic structure of the B sweep generator is identical with that of the A sweep generator. It consists of the B sweep gate, sweep start comparator, B sawtooth generator, sweep length circuit, B sweep enable circuit, and delay pickoff comparator. The B sweep generator requires no holdoff circuit because it operates only during the period the A sweep generator is in the sweep operation. Instead of the holdoff signal, the A sweep gate signal sets the B sweep enable circuit in the enable state.

o Delay pickoff comparator:

The delay pickoff comparator (Q751 - 754) employs a dual FET (Q751) to obtain a certain time relationship as set by the delay time multiplication potentiometer (R773) with respect to the A sweep signal. The comparator compares the A sweep output signal (sawtooth waveform) with the voltage set by R773, generates a delayed sweep start signal, and sets the B sweep gate circuit to start the B sweep signal. When in the B TRIG'D mode, the B sweep gate circuit is not set directly with this delayed sweep start signal but the J (No.3) terminal is set in the high state and the B sweep signal is started as driven by the trigger pulse of the B trigger generator.

## 6.8 Horizontal Switching Circuit

The horizontal switching circuit is comprised of a switching buffer circuit which prevents switching distortion from being transmitted to the preceding and succeeding circuits, a horizontal switching circuit which electronically switches the A and B sweep signals and X-axis signal, and a horizontal switching logic circuit which controls the switching circuit.

o Switching buffer circuit:

The switching buffer circuit is of a grounded-base-type amplifier. Transistor Q901 is for buffer-amplification of the A sweep signal, transistor Q902 for the B sweep signal, and transistor Q904 for the X-axis signal.

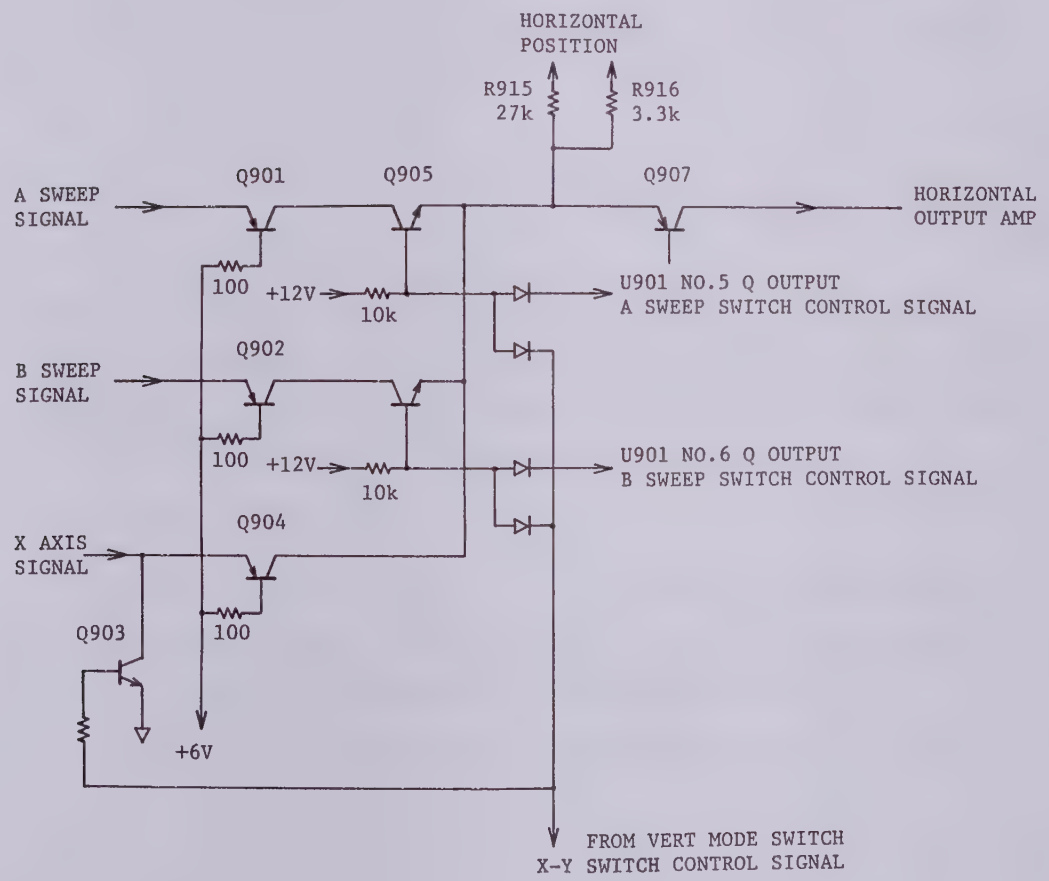



Figure 32

o Horizontal switching circuit:

The horizontal switching circuit, as shown in Figure 32, is a solid-state switching circuit (Q905, 906) which turns on and off the A and B sweep signals by controlling the base voltage. The X-axis signal is turned on and off by controlling with transistor Q703 the emitter of the buffer amplifier (Q904). The switched horizontal signal is superimposed on the horizontal position signal and applied via the buffer amplifier (Q907) to the horizontal output amplifier.

o Horizontal switching logic circuit:

The horizontal switching logic circuit employs a flip-flop TTL IC (U901) with PRESET/CLEAR function. It controls the horizontal switching circuit being dictated by the horizontal display switch. With its U902 IC, it switches the vertical ALT switching pulse signal. U902 3/4 produces a signal for switching the A & B trace separator circuit.

## 6.9 Horizontal Output Amplifier

The horizontal output amplifier consists of the ×10 MAG circuit which selects gain for the horizontal signal fed from the horizontal switching circuit, the drive amplifier which converts the above signal into a balanced signal and drives the output amplifier, and the output amplifier which drives the horizontal deflection plates of the CRT.

o ×10 MAG circuit:

The ×10 MAG circuit switches the gain by switching the load resistors of the circuit which converts the current mode horizontal signal of the horizontal switching circuit into a voltage mode signal.

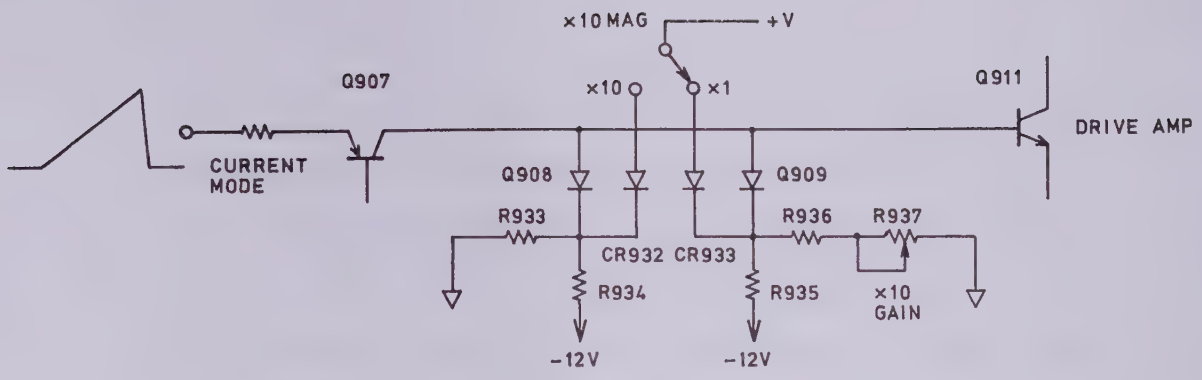



Figure 33

When in the ×1 GAIN mode, diode 909 is in the cut off state as the current flows from the +V supply via CR933. In this case, as CR932 is open, the horizontal signal which is fed through Q907 flows via the diode of Q908 to R933 and is converted into a voltage signal. R934 and R935 are bias resistors.

When in the ×10 MAG mode, the circuit operation is in the reverse of the above. Q908 is cut off, Q909 is on, and the horizontal signal voltage is 10 times of that in the case of the ×1 MAG mode as the resistance is 10 times of R933.

The above voltage-converted signal is fed via the emitter follower (Q910) to the drive circuit and the X-Y alignment circuit of the vertical output amplifier.

o Drive amplifier:

The drive amplifier (Q911, 912) is a differential amplifier. It converts the output of the ×10 circuit into a balanced signal to drive the output amplifier through the diode limiter.

o Output amplifier:

The output amplifier (Q961 - 966) is comprised of feedback-type SRPP amplifiers symmetrical for right and left which provide sufficient speed and output voltage for driving the horizontal deflection plates of the CRT. The signal current-amplified by Q961/Q962 is converted into a voltage signal by Q963/Q964 and at the same time Q965/Q966 is driven as an emitter follower in order to obtain a sufficiently high gain and a sufficiently low output impedance. By means of negative feedback resistor R975/ R976, a stable gain and wide and flat frequency response are attained.

## 6.10 Z-axis Amplifier

The Z-axis amplifier is comprised of an input circuit and an output amplifier. The input circuit merges the unblanking signals of the A and B sweep generators, the external intensity modulation signal applied through the Z-axis input terminal, the B intensity control signal, and the overall intensity control signal. The output amplifier amplifies the merged signal into a sufficient level for driving the G1 grid of CRT.

o Input circuit:

The input circuit produces the main unblanking signal by merging through the gate circuit (U601 1/4, 2/4) the unblanking signals of the A and B sweep generators and the A intensity gate signal of the horizontal switching circuit. The input circuit also merged to the above merged signal, as selected by the horizontal display switch (S901) and the vertical mode switch (S303), the B intensity control signal, the chopped blanking signal, the external intensity modulation signal applied via the X-axis input terminal, and the overall intensity control signal. The resultant compound signal is fed to the output amplifier.

o Output amplifier:

The output amplifier amplifies the above compound signal to several tens volts. It is of a feedback-type SRPP circuit (Q1011 - 1014) similar to that of the horizontal output amplifier. Transistor Q1011 is for the DC compensation circuit for adjusting the Z-axis input terminal signal to the DC level. The amplified unblanking output signal is applied to the G1 grid of the CRT through the CRT circuit in order to control the trace intensity.

## 6.11 CRT Control Circuit

The CRT control circuit is comprised of a linear focus circuit which produces a focus voltage proportional to the intensity by converting the unblanking output signal of the Z-axis amplifier, a DC regeneration circuit which converts the focus voltage and unblanking signal into the operating potentials of the CRT in order to be applied to the focus electrode and G1 electrode of the CRT, semi-fixed potentiometers DEFF SHIELD (R1011), ASTIG (R1013), GEOMETRY (R1015) and SUB-FOCUS (R1041), a trace rotation circuit for adjusting the trace direction in parallel with the horizontal graticule lines, and an illumination circuit for illuminating the graticule.

o Linear focus circuit:

The linear focus circuit (Q1016, 1017) inverts and amplifies by approximately 1.5 times the umblanking signal of the Z-axis amplifier. It also merges at its input the focus control signal for fine adjustment of focus.

o DC regeneration circuit:

The DC regeneration circuit converts the linear focus signal and unblanking signal of several tens to several hundreds volts into

AC signals with the switching signal of the DC-DC converter circuit, and then converts them back into DC signals with respects to the cathode voltage and focus reference voltage of the sub-focus potentiometer in order to provide a focus signal and an unblanking signal of the operating voltages of the CRT.

## 6.12 HV Regulator (High Voltage Generator)

The high voltage generator produces an acceleration voltage (-1500 V) applied to the CRT cathode and a post-acceleration voltage (approximately +8.5 kV) applied to the CRT anode to accelerate the electrons beam which have passed the X and Y deflection plates and mesh electrode. The high voltage generator is a DC-DC converter with a blocking oscillator which generates a high voltage of approximately 1500 Vp-p of a high frequency (approximately 30 kHz) by means of resonance of the secondary coil of a transformer. This high frequency AC voltage is voltage-multiplication-rectified into the +8.5 kV supply and it is double-voltage-rectified into the -1500 V supply. The -1500 V supply is fed through high-resistance feedback resistors (R1052, 1053) to the control circuit (Q1071, 1072) to obtain a stable acceleration voltage. It also is fed through a capacitor-coupling circuit to the DC regeneration circuit in order to be used as the switching signal.

## 6.13 Power Supply Circuit

The power supply circuit steps up or down with its power transformer the AC line voltage into various voltages and rectifies them to DC supply voltages for the various circuits of the oscilloscope. The primary winding of the power transformer is of a split type, in order that the oscilloscope can be operated on various AC line voltages by connecting the transformer taps in series or parallel as required. Regarding the secondary circuit, the transformer has one 6.3 V winding for the CRT heater and four windings

of different voltages for different circuits of the CRT. The AC voltages of these four windings are rectifies and supplied as regulated +230 V, +170 V and +21 V powers and non-regulated +90 V, +40 V, +12 V, +5 V and -12 V powers.

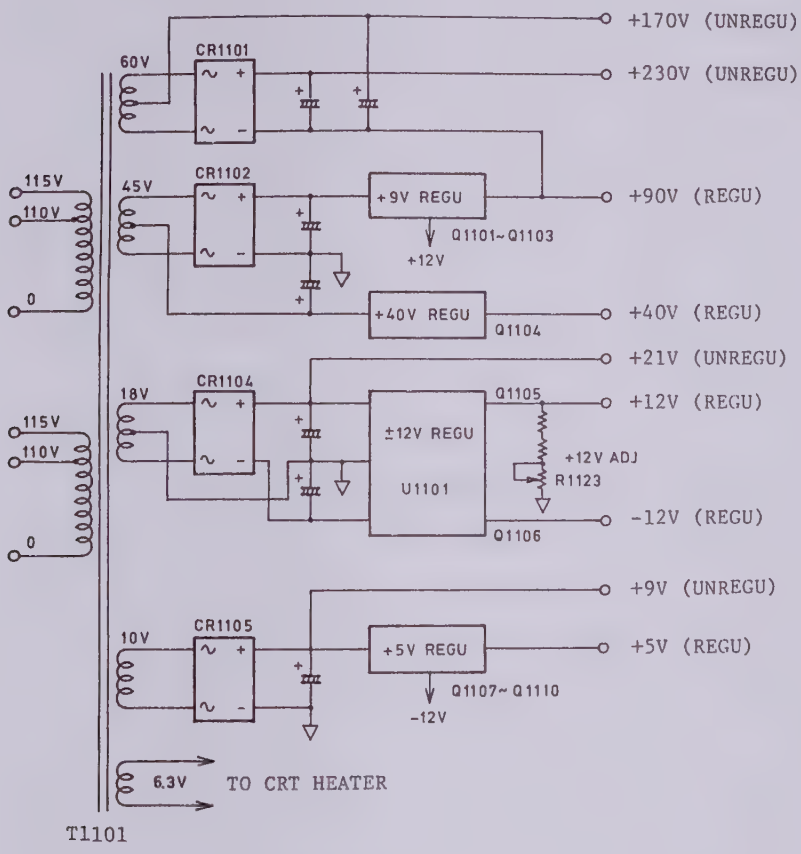



Figure 34

## 6.14 Calibrator Circuit

The calibrator circuit provides square-wave calibration voltage signals of 2 Vp-p and 200 mVp-p which are used for calibration of the probe and the amplifiers when they are operated in the non-calibrated mode. The voltage accuracy of the calibration signals is 2% or better. The calibration signals are produced by generating a signal with the multibrator of CMOS IC (U1102 1/4, 2/4), shaping the waveform with the Schmitt circuit of CMOS IC (U1102 3/4, 4/4), and dividing the voltage signal with resistors.

# 7. CALIBRATION

## 7.1 General

After the oscilloscope has been used for a period of time, it should be calibrated. Although calibration of overall performances is recommended, partial calibration may serve the purpose that the time axis alone is calibrated when the time measuring accuracy is especially important or that the vertical axis alone is calibrated when the vertical sensitivity accuracy is of prime importance. After the oscilloscope has been repaired, overall calibration is suggested although it depends on the type of repair. For accurate calibration service, contact Kikusui's representative in your area.

## 7.2 Removing the Case

To remove the case, remove the six screws (Figure 35) and pull out the chassis forward. To remove the rear cover, remove the four screws shown in Figure 36.

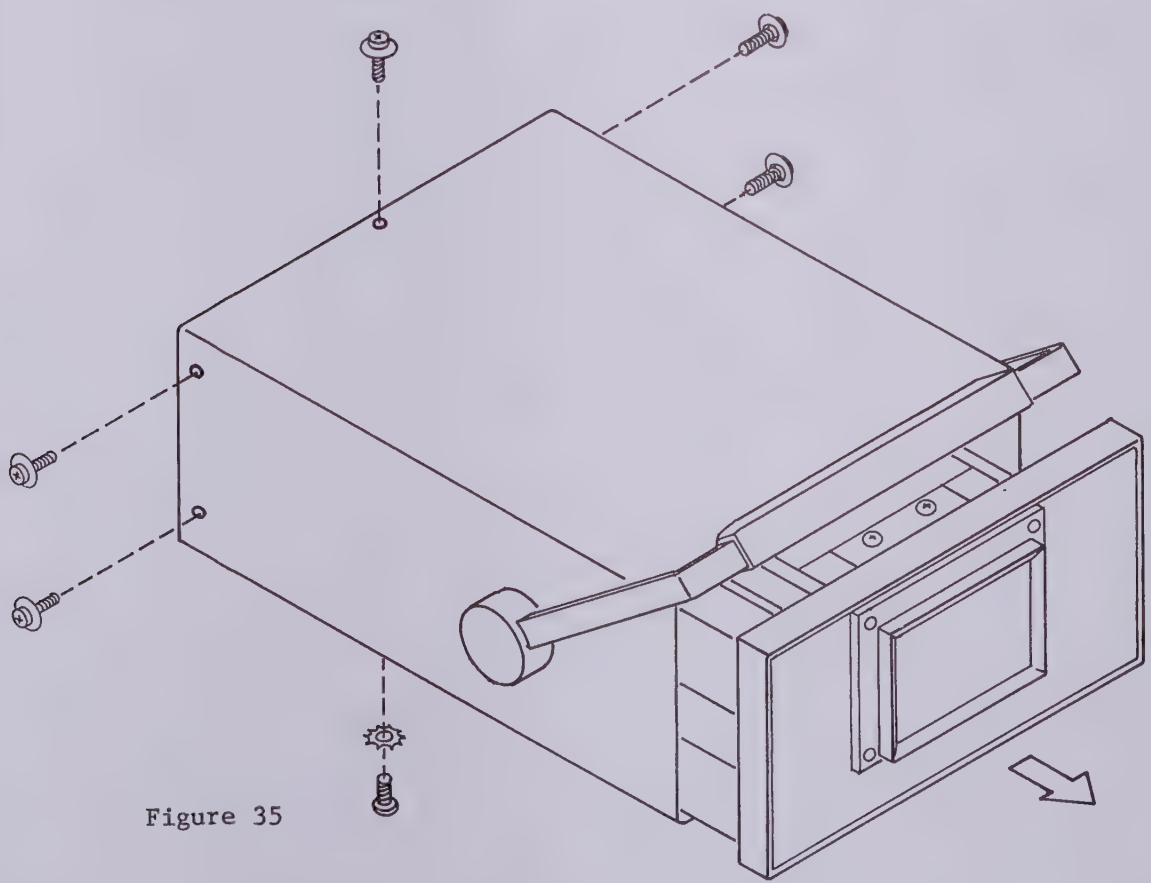


Figure 35

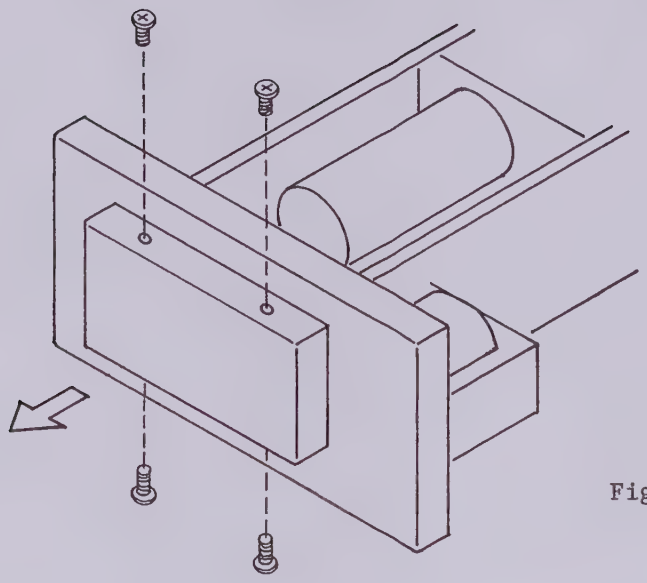


Figure 36

7.3 Check and Adjustment of DC Supply Voltages

Before calibrating the oscilloscope, its DC supply voltages should be checked and adjusted. Check and adjust the +12V supply voltage first and the other supply voltages next. The supply voltages shown in the following table and the check and adjustment points are indicated in Figures 42 and 43.

| Nominal voltage | Voltage range | Check and adjustment points |
|---|---|---|
| + 5 V | +4.75 - 5.25 V | TP-2 |
| +12 V | +11.95 - 12.05 V | TP-3 R1123 |
| -12 V | -11.80 - 12.20 V | TP-1 |
| +40 V | +42 - 48 V | TP-4 |
| +90 V | +92 - 98 V | TP-7 |
| +170 V | +165 - 185 V | TP-6 |
| +230 V | +235 - 265 V | TP-5 |
| -1500 V | -1490 - 1510 V | TP-8 R1056 |

For voltage check, measure the voltage between check point and ground using precision digital voltmeter. The +12V supply must be especially carefully adjusted because it provides a reference for other supplies. To measure the -1500V supply of which internal impedance is high, use a voltmeter of a high input impedance (10 MΩ or over).

Because adjustments of supply voltages largely affects vertical sensitivity and horizontal sweep time, the oscilloscope must be re-calibrated as explained in the subsequent paragraphs.

## 7.4 Adjustment of CRT Circuits

Some adjustments of the CRT circuits directly affect the CRT deflection sensitivity as is the case of "Check and Adjustment of DC Supply Voltages" of the preceding section. After the GEOMETRY, DEFLECTION SHIELD and HORIZ LIMIT are adjusted, the vertical sensitivity and sweep time must be calibrated.

- Adjustment of SUB INTEN:

  This control is for adjusting the operating position of the INTEN knob (23) .

  (1) Set the TIME/DIV switch (45) at 1 mS and display the single-line horizontal trace on the screen.

  (2) Set the white mark of the INTEN knob in the upright position (noon position) and so adjust the SUB INTEN control (Figure 43, R1017) that the trace is displayed on the screen with a barely discernible intensity.

- Adjustment of GEOMETRY:

  This control is for reducing geometrical distortions (pincushion distortions or barrel distortions) of the pattern displayed on the screen.

  (1) Apply a sinusoidal signal of approximately 50 kHz to vertical input terminal (9) or (15) and display the signal with an amplitude of 8 DIV and with approximately 50 peaks.

  (2) So adjust the GEOMETRY control (Figure 43, R1015) that the displayed pattern becomes as (b) in Figure 37.

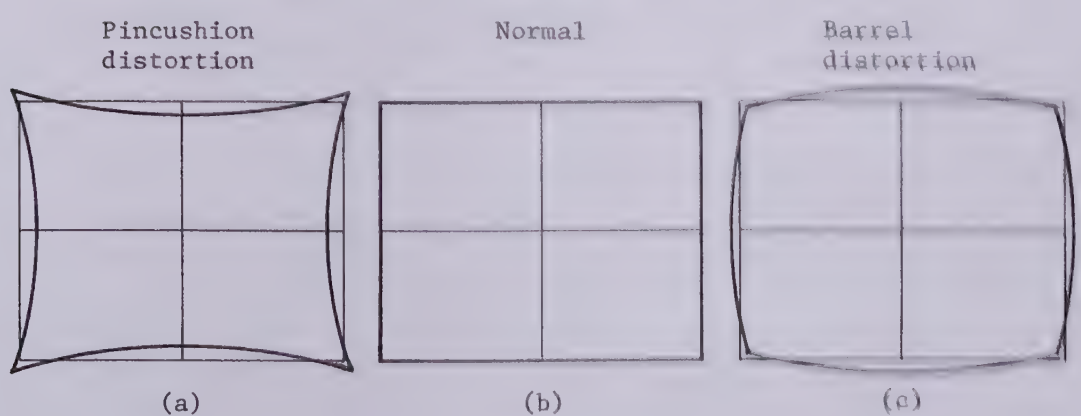



Figure 37

o Adjustment of DEFLECTION SHIELD:

This control is used to reduce halation on the screen for improving the contrast and to improve the linearity of the displayed waveform.
So adjust the DEFLECTION SHIELD control (Figure 43, R1011) that the best focus is obtained with the ASTIG voltage set at +70 to +80 volts.

o Adjustment of SUB-FOCUS:

This control is for adjusting the control range position of the FOCUS knob (25) . With the FOCUS knob set with its white dot positioned upright (noon position), so adjust the SUB-FOCUS control (Figure 43, R1041) that the best focus is obtained.

o Adjustment of HORIZ LIMIT:

This control is used to suppress halation (caused by the electron beam reflected and scattered in the cathode-ray tube) resulting from change in the horizontal POSITION adjustment and 10 × MAG operation.

(1) Apply the CALIB signal (28) and (29) to the vertical input terminals and display waveforms of an amplitude of 4 DIV and 10 peaks.

(2) Turn ON ( ▬ ) the 10 × MAG switch (39) . Turn the HORIZ LIMIT control (Figure 44, R961) from the extremely counter-clockwise position gradually to clockwise position and stop at the position where halation on the screen is reduced. This is the normal position for the HORIZ LIMIT control. (If you turn the control excessively clockwise, the displayed waveform may away to right and left when the LINE voltage is lower by approximately -10% than the nominal voltage.)

o Adjustment of Y AXIS ALIGN:

This control is for adjustment of the perpendicularity (90°) between horizontal trace (sweep) and vertical trace.

(1) Ground CH1. Apply to CH2 the output of a sine wave signal generator and display the signal with an amplitude of 8 DIV on the screen.

(2) Set the VERT MODE switch (1) in the X-Y mode and so adjust the TRACE ROTATION control (26) that the vertical trace becomes parallel with the graticule scale.

(3) Next, change the VERT MODE switch to CH1 and so adjust the Y AXIS ALIGN (Figure 45, R468) that the horizontal trace becomes parallel with the horizontal scale of the graticule.

By the above procedure, the horizontal trace and vertical trace are adjusted mutually perpendicular.

## 7.5 Adjustment of Vertical Axis

o Adjustment of DC BAL:

This control is for minimizing the shift of the trace when the VARIABLE knob (6) or (14) is turned.

(1) Set the AC-GND-DC switch (8) or (16) in the GND state and display the trace on the CRT screen.

(2) Turning the VARIABLE knob, so adjust the DC BAL control that the shift of the trace becomes minimum. (Figure 45, R131 and R231).

o Adjustment of 5 × MAG BAL:

This control is for minimizing the shift of trace when the 5 × MAG switch (4) or (17) is changed.

(1) Set the AC-GND-DC switch (8) or (16) in the GND state and display the trace on the screen.

(2) Turning ON (▂) and OFF (▆) the 5 × MAG switch, so adjust the 5 × BAL (Figure 45, R164 or R264) that the shift of trace becomes minimum.

o Sensitivity Calibration:

Calibrate the sensitivity of the vertical amplifier to the value indicated by the VOLTS/DIV switch (5) or (13). For this adjustment, use a square wave generator with an output voltage setting accuracy of 0.3% or better at 1 kHz.

(1) Set the signal generator output at 40 mVp-p and apply the signal to the vertical input terminal (9) or (15).

(2) Set the VARIABLE knob (6) or (14) at the CAL'D position and set the VOLTS/DIV switch at the 5 mV range.

(3) So adjust the 5 mV GAIN control (Figure 45, R141 or R241) that the amplitude of the displayed waveform becomes 8 DIV.

(4) Next, set the generator output at 8 mV and turn ON (▬) the 5 × MAG switch (4) or (17).

(5) So adjust the 5 × GAIN control (Figure 45, R167 or R267) that the amplitude of the displayed waveform becomes 8 DIV.

By the above procedure, other ranges also are calibrated to an accuracy of ±3% or better.

o Adjustment or INV BAL:

This control is for minimizing the shift of trace when the CH2 POLARITY switch is changed.

(1) Set the AC-GND-DC switch (16) in the GND state and display the trace on the screen.

(2) Turning ON (▬) and OFF (▮) the CH2 POLARITY switch, so adjust the INV BAL control (Figure 45, R295) that the shift of trace becomes minimum.

o Adjustment of ADD BAL:

With both CH1 and CH2 channels operating in the single-line horizontal trace mode, so adjust this control that the traces do not shift when the VERT MODE switch is changed to the ADD mode.

(1) Set the AC-GND-DC switches (8) and (16) in the GND state and display the traces of the two channels overlapped in the center of the screen.

(2) Change the VERT MODE switch to the ADD state and so adjust the ADD BAL control (Figure 45, R402) that the trace are positioned in the center of the screen.

o Adjustment of square wave characteristics of vertical amplifiers:

This adjustment should be done to adjust the square wave characteristics of the vertical amplifiers so that their frequency response becomes flat. The adjustment should be done at a range

which dose not use the input attenuator (5 mV/DIV range), using two or more square waves of different frequencies.

The adjustment should be done using a quality square wave with rise time 3.5 nsec or faster, and should be done in the order of low, middle, higher middle, and high ranges, repeating adjustment in this order of different frequencies for a few times.

(1) Adjustment for low frequency range:

Set the VOLTS/DIV switch at 5 mV/DIV and the TIME/DIV switch at 2 mS/DIV. Apply to the vertical input terminal a square wave of 100 Hz and so adjust the signal generator output that the waveform with an amplitude of 6 DIV is displayed.

Next, so adjust R446 (Figure 45) that the displayed waveform becomes as (b) in Figure 38.

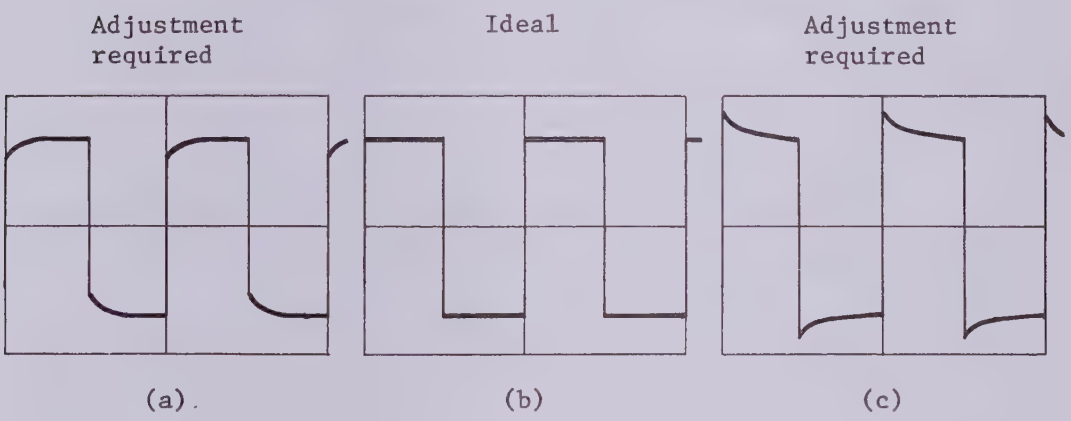



Figure 38

(2) Adjustment for middle frequency range:

Change the input pulse signal frequency to 20 kHz and set the TIME/DIV switch at 10 $\mu$S/DIV. Next, so adjust R409 and C404 (Figure 45) that a square wave as shown in (d) of Figure 39 is displayed. For this adjustment, set R409 at an appropriate position and then adjust C404 so that a waveform as close to that of (d) as possible is obtained. Repeat this procedure for a few times so that a waveform as shown in (d) is obtained.

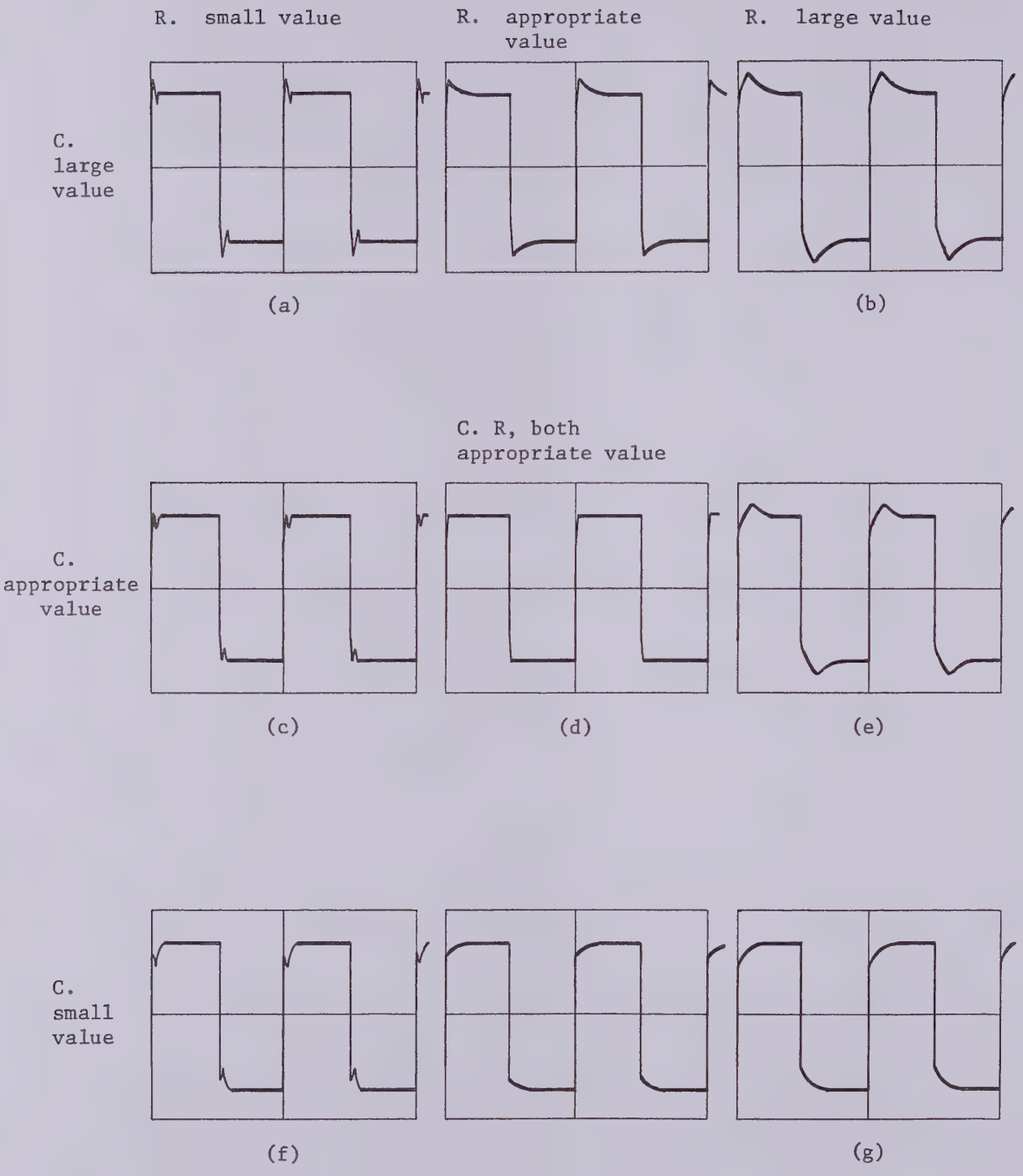

R. small value
R. appropriate value
R. large value
C. large value
(a)
(b)
C. R, both appropriate value
C. appropriate value
(c)
(d)
(e)
C. small value
(f)
(g)

Figure 39

(3) Adjustment for higher middle frequency range:

Change the input square wave signal to 200 kHz and set the TIME/DIV switch at 1 $\mu$S/DIV. Next, in a similar manner as the case for "adjustment for middle frequency range," so adjust R178 and C143 for CH1 or R278 and C243 for CH2 that a waveform as shown in (d) of Figure 39 is displayed.

(4) Adjustment for high frequency range:

Change the input square wave signal to 1 MHz and set the TIME/DIV switch at 0.2 $\mu$S/DIV. Next, in a similar manner as the case for "adjustment for middle frequency range," so adjust R408 and C403 or R447 and C429 that a waveform as shown in (d) of Figure 39 is obtained.

Next, adjust the amplitude of the pulse signal to 4 DIV and so adjust R448, C430 and C133 or C233 that the front edge of the square wave becomes flat.

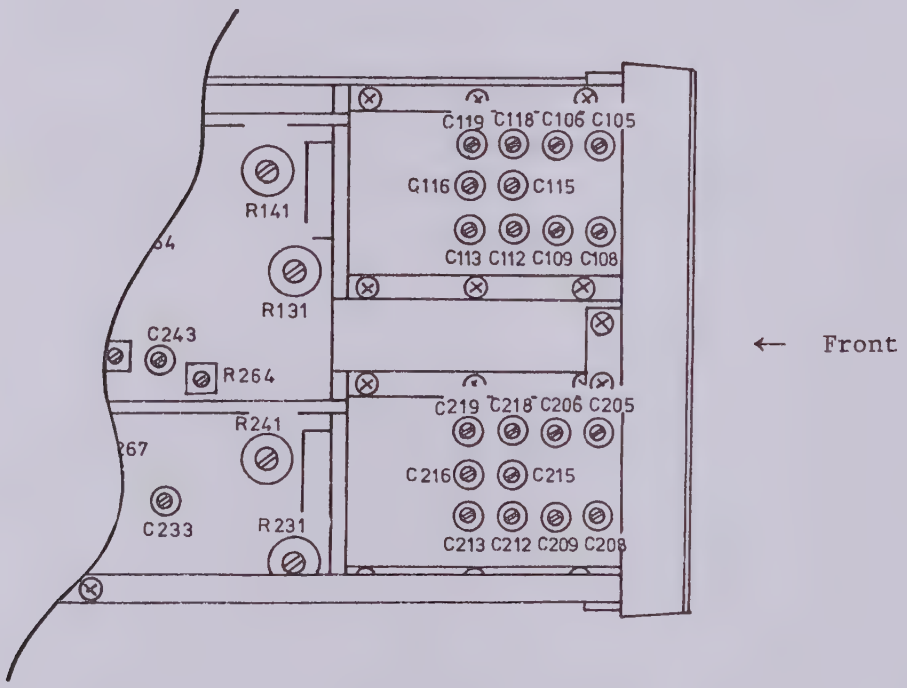
o Adjustment of input ATT:

The VOLTS/DIV switch selects the oscilloscope sensitivity by switching the attenuator circuit consisting of pre-stage attenuator (1/10-steps) and post-stage attenuator (1/2, 1/4, 1/10-steps). This procedure is for phase compensation and input capacitance adjustment of the attenuators. Adjustments should be done in the order of phase compensation and input capacitance adjustment for the post-stage attenuator and then phase compensation and input capacitance adjustment of the pre-stage attenuator.

(1) Adjustment of post-stage attenuator:

Use a square wave signal generator which provides a quality square wave of rise time 1 $\mu$sec or faster, without sags or overshoots. Apply the signal for each of the ranges (10 mV, 20 mV, 50 mV) and display a waveform with an amplitude of 6 DIV. So adjust the phase compensation capacitor shown in the following table that an ideal waveform is displayed. Next, connect a low-capacitance C-meter to the input terminal and so adjust the input-capacitance compensation capacitor that the input capacitance at each range becomes 20 pF ±2 pF.

| Compensation capacitor / Range | CH1 | | CH2 | |
|---|---|---|---|---|
| | Phase compen-sation | Input capacitor | Phase compen-sation | Input capacitor |
| 10 mV (1/2) | C113 | C112 | C213 | C212 |
| 20 mV (1/4) | C116 | C115 | C216 | C215 |
| 50 mV (1/10) | C119 | C118 | C219 | C218 |




(Left hand side view)

(2) Adjustment of post-stage attenuator:

In a similar manner as (1) above, adjust the phase compensation capacitor and input-capacitance compensation capacitors shown in the following table for each of the ranges (5 mV, 0.1 V, 1 V).

| Compensation capacitor / Range | CH1 | | CH2 | |
|---|---|---|---|---|
| | Phase compen-sation | Input capacitor | Phase compen-sation | Input capacitor |
| 5 mV (1/1) | - | - | - | - |
| 0.1 V (1/10) | C106 | C105 | C206 | C205 |
| 1 V (1/100) | C109 | C108 | C209 | C208 |

When the above adjustment is done, all other ranges also are automatically adjusted.

## 7.6 Adjustment of Trigger Circuits

o Adjustment of TRIG. LOCK:

This adjustment is for making optimum the TRIG.LOCK sensitivity of the trigger circuit of the A sweep.

(1) Apply a sinusoidal wave of approximately 1 kHz to the vertical input terminal and display a waveform with an amplitude of approximately 8 DIV on the screen.

(2) Turn the LEVEL knob (33) to the extremely clockwise position (LOCK position).

(3) Turning ON ( ▂ ) and OFF ( ▉ ) the SLOPE push button, so adjust R539 and R555 (Figure 42) that the start point of the waveform becomes the center of the displayed waveform amplitude.

(4) Next, apply a sinusoidal wave of approximately 35 MHz to the vertical input terminal and so adjust the signal generator output that the signal is displayed with an amplitude of 0.5 DIV on the screen.

(5) Under the above state, finely re-adjust R539 and R555 that the triggering does not fail when the SLOPE pushbutton is turned ON ( ▂ ) and OFF ( ▉ ).

o Adjustment of TRIG LOCK of B sweep:

This adjustment is for making optimum the TRIG LOCK sensitivity of the trigger circuit of the B sweep. Adjust R618 and R634

(Figure 42) in a similar manner as in the case of "Adjustment of TRIG LOCK."

o Adjustment of TRIG DC OFFSET (for trigger circuit of A sweep only):

This adjustment is for attaining such state that, when the trigger signal is AC-coupled and the white dot of the LEVEL knob is set in the upright position (noon position), the trigger point is at the center of the displayed waveform amplitude.

(1) Apply a sinusoidal wave of approximately 1 kHz to the vertical input terminal and display the signal waveform with an amplitude of approximately 8 DIV on the screen.

(2) So set the LEVEL knob that its white dot is positioned at the noon position. So adjust R533 (Figure 42) that the trigger point (trace start point) is positioned at the center of the displayed waveform amplitude.

o Adjustment of CH1 TRIG DC OFFSET:

This adjustment is for offsetting to zero the DC-component displacement of the CH1 internal trigger output.

(1) Apply a sinusoidal signal of approximately 1 kHz to the CH1 input terminal and set the AC-GND-DC switch at AC.

(2) Set the VERT MODE switch at CH1, set the INT TRIG switch at CH1 or NORM, and display the signal with an amplitude of 8 DIV on the screen.

(3) Set the COUPLING switch at AC and so adjust the LEVEL knob that the trigger point is brought to the center of the displayed waveform amplitude.

(4) Change the COUPLING switch to DC and so adjust the CH1 TRIG DC OFFSET (Figure 45, R307) that the trigger point is brought to the center of the dispalayed waveform amplitude.

* This adjustment affects the X-Y positions. Be sure to adjust the X-Y POSITION ADJ after this adjustment has been done.

o Adjustment of CH2 TRIG DC OFFSET:

This adjustment is for offsetting to zero the DC-component displacement of the CH2 internal trigger output.

For this adjustment, adjust CH2 TRIG DC OFFSET (Figure 45, R316) in a similar manner as is the case for "Adjustment of CH1 TRIG DC OFFSET."

## 7.7 Adjustment of Time Base

o Calibration of A sweep time:

This adjustment is for calibrating the sweep time to the values indicated by the TIME/DIV switch. For this adjustment, use time marker signals of accurate time intervals of 1 msec and 1 sec or use signals of accurate frequencies of 1 kHz and 100 kHz.

(1) Apply to the vertical input terminal a time marker signal of 1 msec or a signal of 1 kHz, and deflect the signal with an appropriate amplitude on the screen.

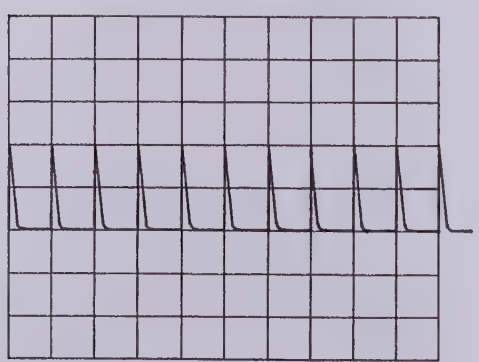
(2) Set the VARIABLE knob (44) in the CAL'D position. Set the TIME/DIV switch (45) at 1 mS.

(3) So adjust the A SWEEP CAL (Figure 46, R822) that the displayed waveform conforms with scale divisions of the graticule.

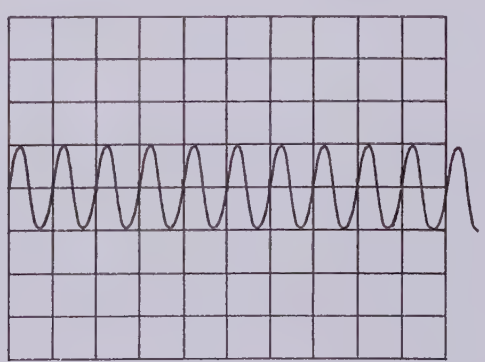
(4) Change the input signal to a time marker signal of 10 $\mu$S or sinusoidal wave signal of 100 kHz and change the TIME/DIV switch (45) to 10 $\mu$S.

(5) So adjust the A 10 $\mu$S CAL (Figure 46, C802) that the displayed signal waveform conforms with scale divisions of the graticule.

When the above calibration is complete, the sweep speeds of the remaining ranges also are calibrated at an accuracy of ±3%.



Time marker signal



Sinusoidal wave signal

Figure 40

o Calibration of B sweep time:

Calibrate the sweep time to the indicated values of the TIME/DIV switch (46). Adjust the B SWEEP CAL (Figure 46, R871) and B 10 μS CAL (Figure 46, C852) in a similar manner as that for the case of "Calibration of A sweep time."

o Adjustment of LENGTH:

This adjustment is for setting the lengths of the A and B sweeps at 11 DIV. Set the TIME/DIV switches (45) and (46) at 1 mS and apply a time marker signal of 1 msec or a signal of repetition frequency 1 kHz, and so adjust the A SWEEP LENGTH (Figure 42, R725) and B SWEEP LENGTH (Figure 42, R735) that the sweep lengths become 11 DIV.

o Adjustment of sweep start point:

This adjustment is for attaining such state that, when the horizontal POSITION knobs (47) and (48) are set with their white dots in the noon positions, their sweeps start at the left hand end of the graticule.

(1) Set the TIME/DIV switches (45) and (46) at 1 mS, set the HORIZ DISPLAY switch (50) at ALT, and display both A and B sweeps on the screen.

(2) So set the horizontal POSITION knobs (47) and (48) that their white dots are positioned upward (noon position). So adjust the A SWEEP POSITION (Figure 46, R902) that the start point of the A sweep is brought to the left hand end of the graticule.

(3) Next, with the B SWEEP POSITION (Figure 46, R906), bring the start point of the B trace to the left hand end of the graticule.

o Adjustment of 10 × MAG DC BAL:

This adjustment is for attaining such a state that, when the 10 × MAG switch (39) is turned ON ( ▬ ), the displayed waveform is magnified to right and left from the center of the screen.

(1) Set the TIME/DIV switch (45) at 1 mS. So adjust the horizontal POSITION knob that the start point of the sweep is brought to the center of the screen.

(2) Turn ON ( ▬ ) the 10 × MAG switch. So adjust the 10 × BAL (Figure 46, R939) that the start point of the sweep is brought to the center of the graticule.

o Adjustment of 10 × MAG:

This adjustment is for calibration of the sweep time when the 10 × MAG switch (39) is turned ON ( ▬ ). Before performing this adjustment, make sure that the adjustment for "Calibration of the A sweep time" has been done.

(1) Apply to the vertical input terminal a time marker signal of 0.1 mS or a signal of 10 kHz and display the signal with an appropriate amplitude on the screen.

(2) Set the VARIABLE knob (44) in the CAL'D position and the TIME/DIV switch (45) at 1 mS.

(3) Turn ON ( ▬ ) the 10 × MAG switch and so adjust the 10 × CAL (Figure 46, R937) that the displayed waveform conforms with scale divisions of the graticule.

o Calibration of DELAY TIME MULTI:

This calibration is for calibrating the dail value of the DELAY TIME MULTI to the sweep time. Before performing this calibration, make sure that the adjustment for "Calibration for A sweep time" has been done.

(1) Apply to the vertical input terminal a time marker signal of 1 mS and display the waveform with an appropriate amplitude on the screen.

(2) Set the VARIABLE knob (44) in the CAL'D position, set the TIME/DIV switch (45) at 1 mS, set the TIME/DIV switch (46) at 10 $\mu$S, and change the HORIZ DISPLAY switch (50) to the A INTEN state.

(3) Set the dial indication of the DELAY TIME MULTI at 1.00 and align the displayed waveform with graticule.

(4) So adjust the B START LEVEL (Figure 46, R764) that the accentuated portion of the waveform is aligned to the initial pulse as shown in Figure 41.

(5) Set the dial indication of the DELAY TIME MULTI at 10.00.

(6) So adjust the B END LEVEL (Figure 46, R769) that the accentuated portion of the waveform is aligned to the 10th pulse.

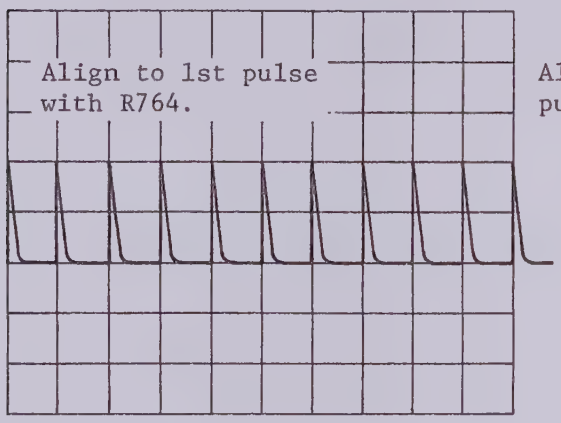



Figure 41

## 7.8 Adjustment of Horizontal Axis (X-axis)

o Calibration of horizontal sensitivity:

This adjustment is for calibration of the X-axis sensitivity for X-Y operation.

(1) Set at 50 mVp-p the output of the signal generator used for "Calibration of sensitivity" of section 7.5, and apply the output to the CH1 (X-axis) input.

(2) Set the VERT MODE switch (1) in the X-Y state. Set the AC-GND-DC switch (15) of CH2 (Y-axis) at GND.

(3) Set the VARIABLE knob (6) at CAL'D and the VOLTS/DIV switch (5) at 5 mV.

(4) So adjust the X-GAIN (Figure 45, R304) that the trace length becomes 10 DIV.

* This adjustment affects CH1 TRIG DC OFFSET adjustment and X-Y POSITION adjustment. Be sure to repeat these adjustments after the horizontal axis sensitivity adjustment is done.

o Adjustment of X-Y POSITION:

This adjustment is to obtain such a state that the spot is positioned in the center of the screen when the horizontal POSITION knobs (47) and (48) are set with their white dot positioned upward (noon position) in the X-Y operation.

(1) Operate the oscilloscope in the X-Y mode and set both inputs in the GND state.

(2) Set the horizontal POSITION knobs (47) and (48) with their white dot positioned upward (noon position) and so adjust the X-Y POSITION (Figure 46, R909) that the spot is positioned in the center of the screen.

7.9 Adjustment of Calibration Voltage

o Adjustment of repetition frequency:

(1) Connect the CALIB output (28) or (29) to a frequency counter.

(2) So adjust the CALIB FREQ (Figure 42, R1152) that the frequency counter reads 1 kHz.

o Calibration of the output voltage:

This adjustment is for calibrating the output voltage of the calibration signal in a substitution method.

(1) Set at 200 mVp-p the signal of the generator used for "calibration of sensitivity" of Section 7.5. Apply this signal to the CH1 input terminal.

(2) Display the signal on the screen with an amplitude of 8 DIV by adjusting the VOLTS/DIV switch (5) and VARIABLE knob (6).

(3) Apply the 200 mV CALIB output (28) to the CH1 input terminal. So adjust the CAL OUT (Figure 42, R1160) that the signal is displayed with an smplitude of 8 DIV on the screen in the same manner as step (2) above.

This completes the CAL voltage ADJ procedure.

| | |
|---|---|
| R533 | TRIG LEVEL CENTER |
| R539 | TRIG LOCK BAL (A SWEEP) |
| R555 | TRIG SENS (A SWEEP) |
| R618 | TRIG LOCK BAL (B SWEEP) |
| R634 | TRIG SENS (B SWEEP) |
| R725 | A SWEEP LENGTH |
| R735 | B SWEEP LENGTH |
| R1123 | +12V ADJ |
| R1152 | CALIB FREQ |
| R1160 | CALIB OUTPUT LEVEL |

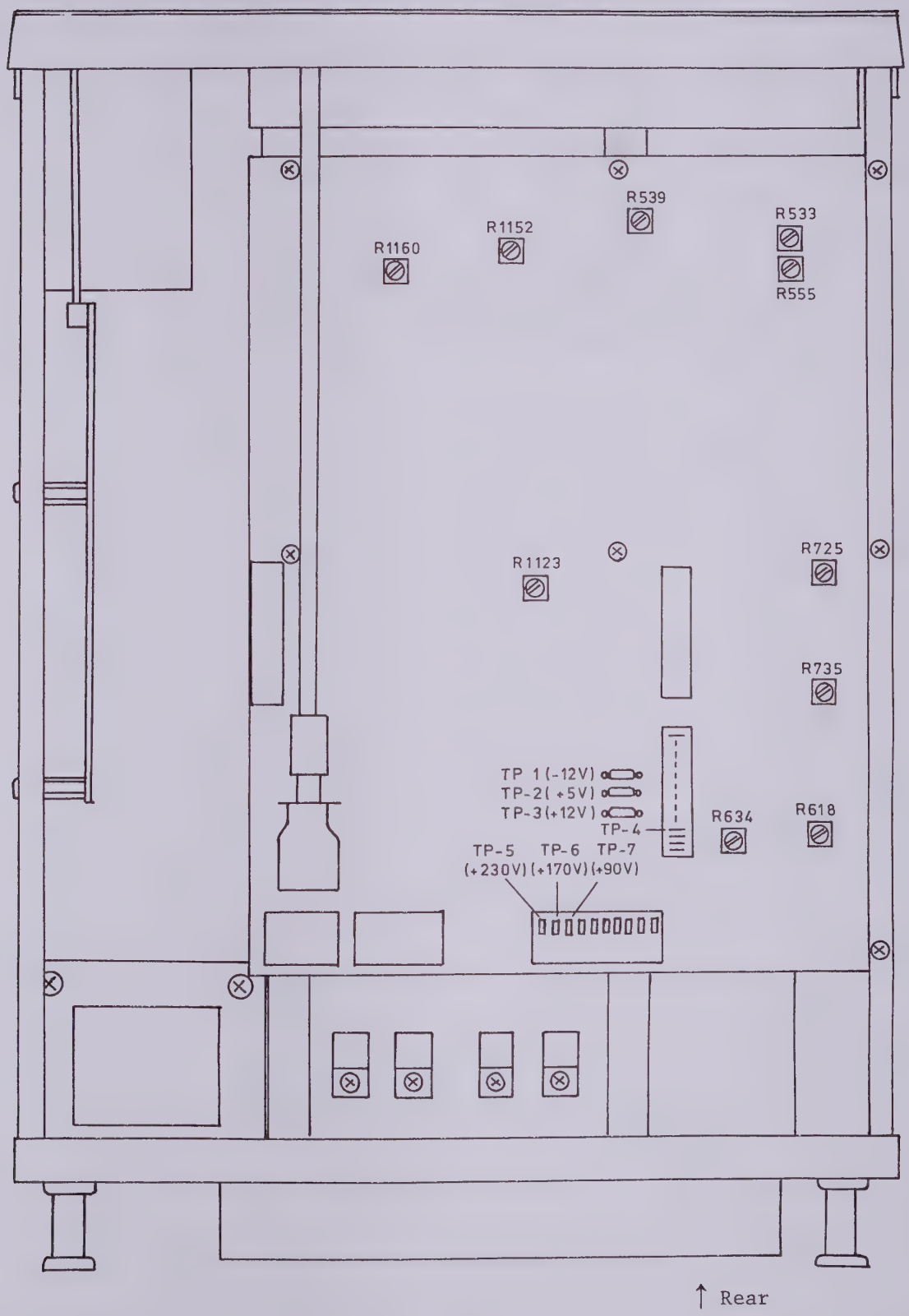



Figure 42 (Bottom view)

| | |
|---|---|
| R1011 | DEFF SHILD |
| R1013 | ASTIG |
| R1015 | GEOMETRY |
| R1017 | SUB INTEN |
| R1041 | SUB FOCUS |
| R1056 | HV ADJ (-1500V) |
| TP-8 | -1500V |
| R961 | HORIZ LIMIT |

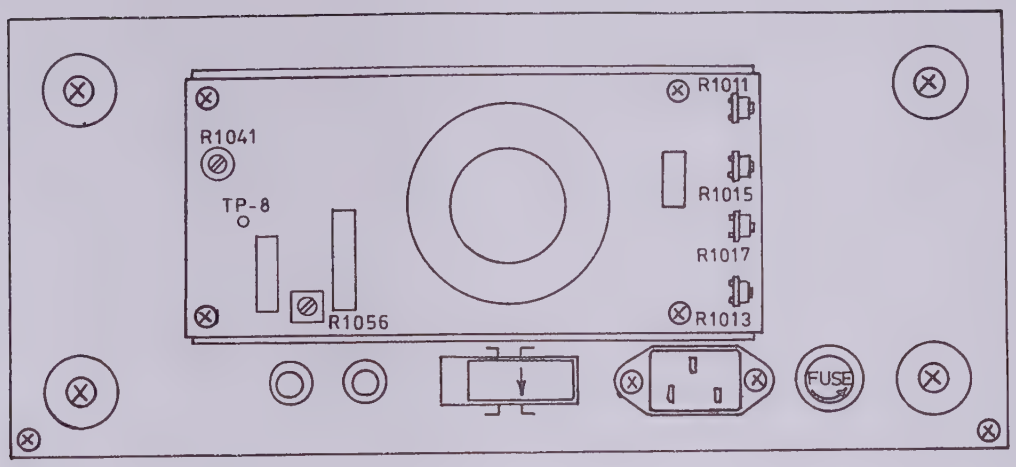



Figure 43 (Rear view)

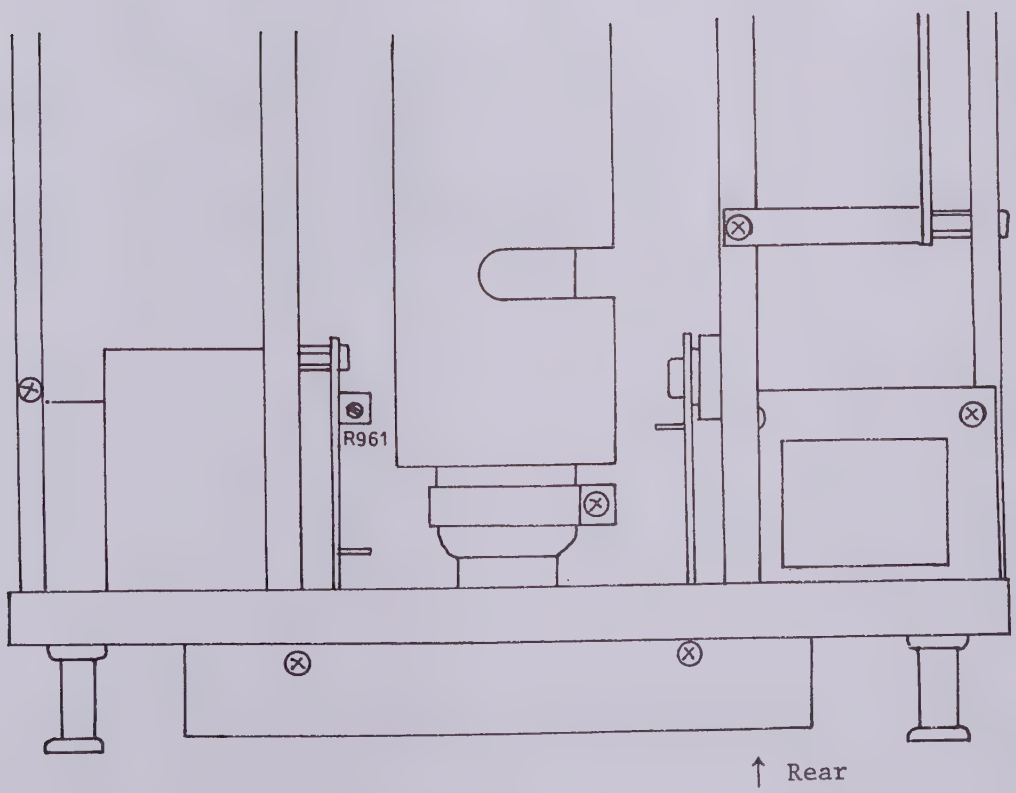



Figure 44 (Top view)

| | |
|---|---|
| R131 | CH1 DC BAL |
| R141 | CH1 5mV GAIN |
| R164 | CH1 5 × MAG BAL |
| R167 | CH1 5 × MAG GAIN |
| R178 | CH1 higher middle freq range |
| R231 | CH2 DC BAL |
| R241 | CH2 5mV GAIN |
| R264 | CH2 5 × MAG BAL |
| R267 | CH2 5 × MAG GAIN |
| R278 | CH2 higher middle freq range |
| R295 | CH2 INV BAL |
| R304 | X AXIS GAIN |
| R307 | CH1 TRIG DC OFFSET |
| R317 | CH2 TRIG DC OFFSET |
| R402 | ADD BAL |
| R408 | High freq range |
| R409 | Middle freq range |
| R446 | Low freq range |
| R447 | High freq range |
| R448 | High freq range, front edge of square wave |
| R469 | Y AXIS ALIGN |

| | |
|---|---|
| C105 | CH1 0.1V (1/10) input cap |
| C106 | CH1 0.1V (1/10) phase comp |
| C108 | CH1 1V (1/100) input cap |
| C109 | CH1 1V (1/100) phase comp |
| C112 | CH1 10mV input cap |
| C113 | CH1 10mV phase comp |
| C115 | CH1 20mV input cap |
| C116 | CH1 20mV phase comp |
| C118 | CH1 50mV input cap |
| C119 | CH1 50mV phase comp |
| C133 | CH1 higher freq range |
| C143 | CH1 higher middle freq range |
| C205 | CH2 0.1V (1/10) input cap |
| C206 | CH2 0.1V (1/10) phase comp |
| C208 | CH2 1V (1/100) input cap |
| C209 | CH2 1V (1/100) phase comp |
| C212 | CH2 10mV input cap |
| C213 | CH2 10mV phase comp |
| C215 | CH2 20mV input cap |
| C216 | CH2 20mV phase comp |
| C218 | CH2 50mV input cap |
| C219 | CH2 50mV phase comp |
| C233 | CH2 higher freq range |
| C243 | CH2 higher middle freq range |
| C403 | High freq range |
| C404 | Middle freq range |
| C429 | High freq range |
| C430 | High freq range, front edge of square wave |

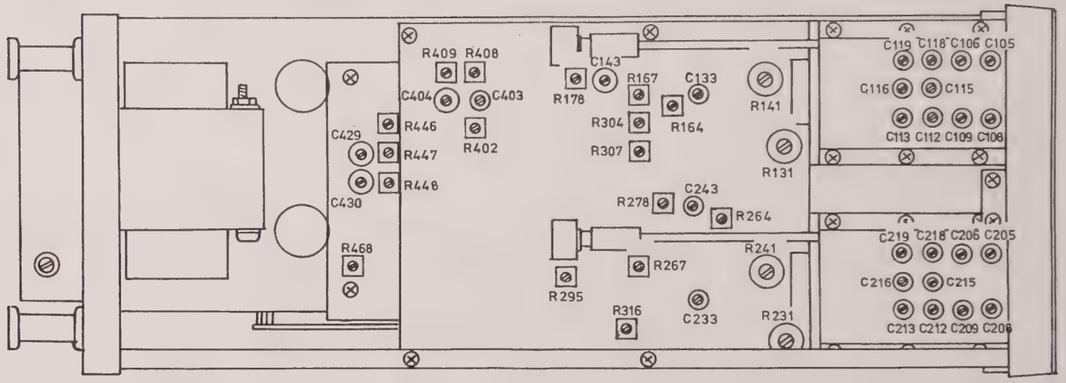



Figure 45 (Left hand side view)

R764 B START LEVEL

R769 B END LEVEL

R822 A SWEEP CAL

R871 B SWEEP CAL

R902 A SWEEP START POINT

R906 B SWEEP START POINT

R909 X-Y POSITION

R936 10 × MAG CAL

R939 10 × MAG DC BAL

C802 A SWEEP CAL (10 $\mu$sec)

C852 B SWEEP CAL (10 $\mu$sec)

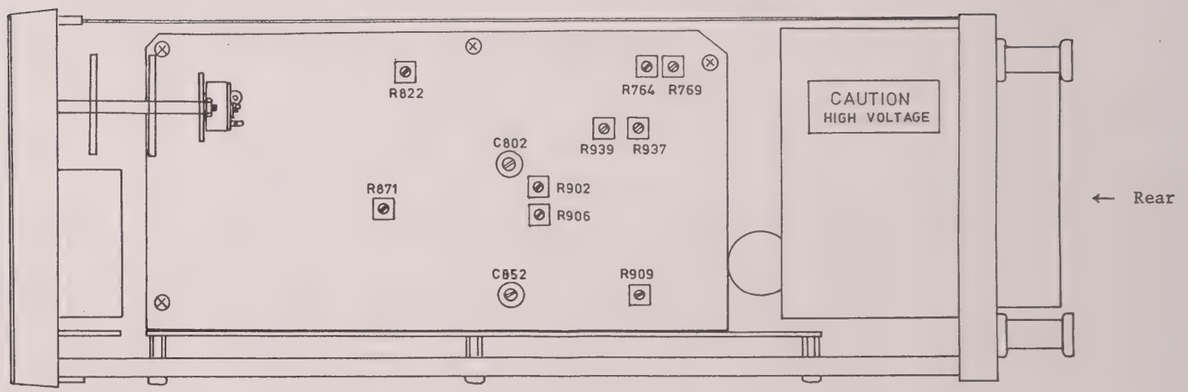



Figure 46 (Right hand side view)

## 7.10 Calibration of Probe

As explained previously, the probe makes up a wide-range attenuator. Unless phase compensation is properly done, the displayed waveform is distorted causing measurement errors. Therefore, the prove must be properly compensated before use.

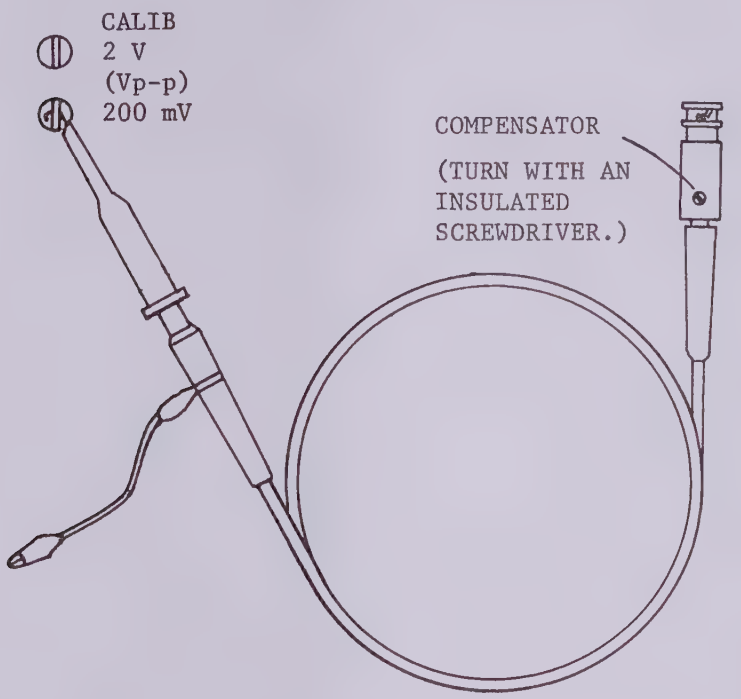



Figure 47

Connect the probe BNC to the INPUT terminal of CH1 or CH2 and set VOLTS/DIV switch at 5 mV. Connect the probe tip to the calibration voltage output terminal and adjust the COMPENSATOR control with an insulated screwdriver so that an ideal waveform as illustrated below is obtained.

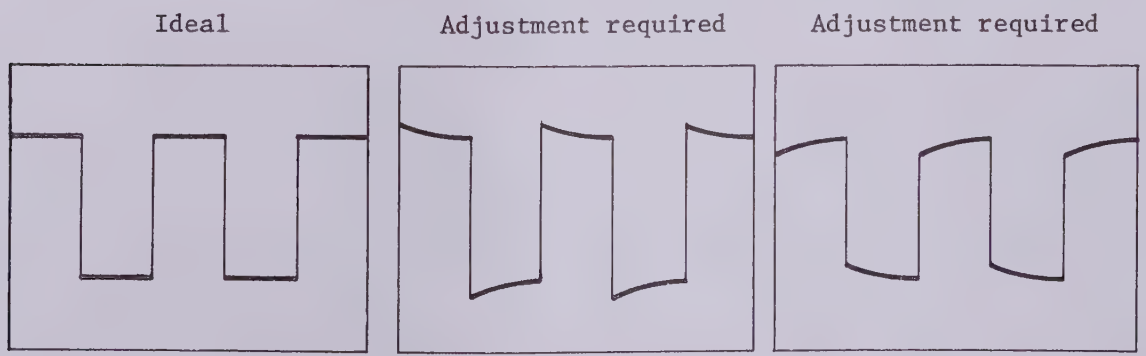
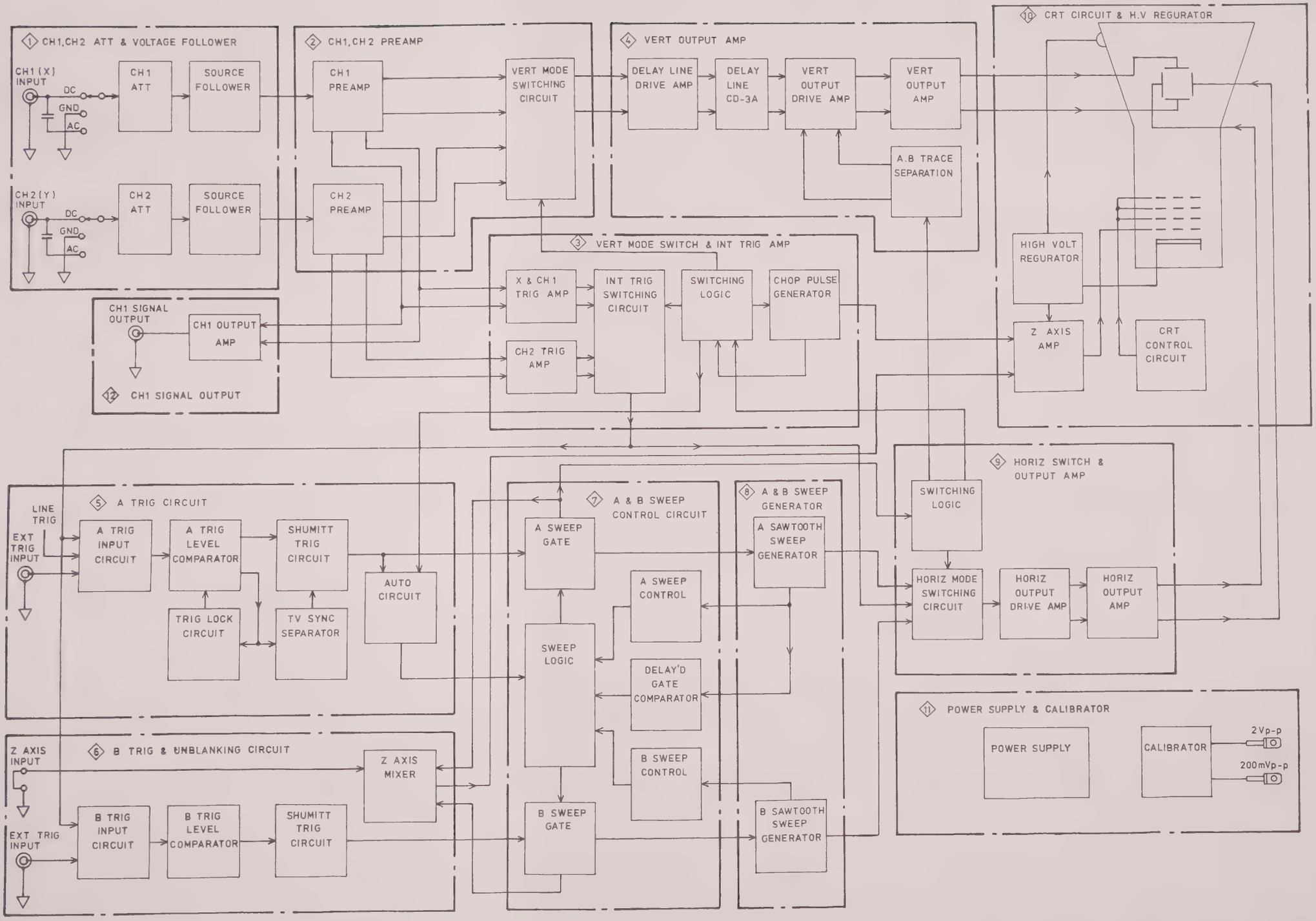
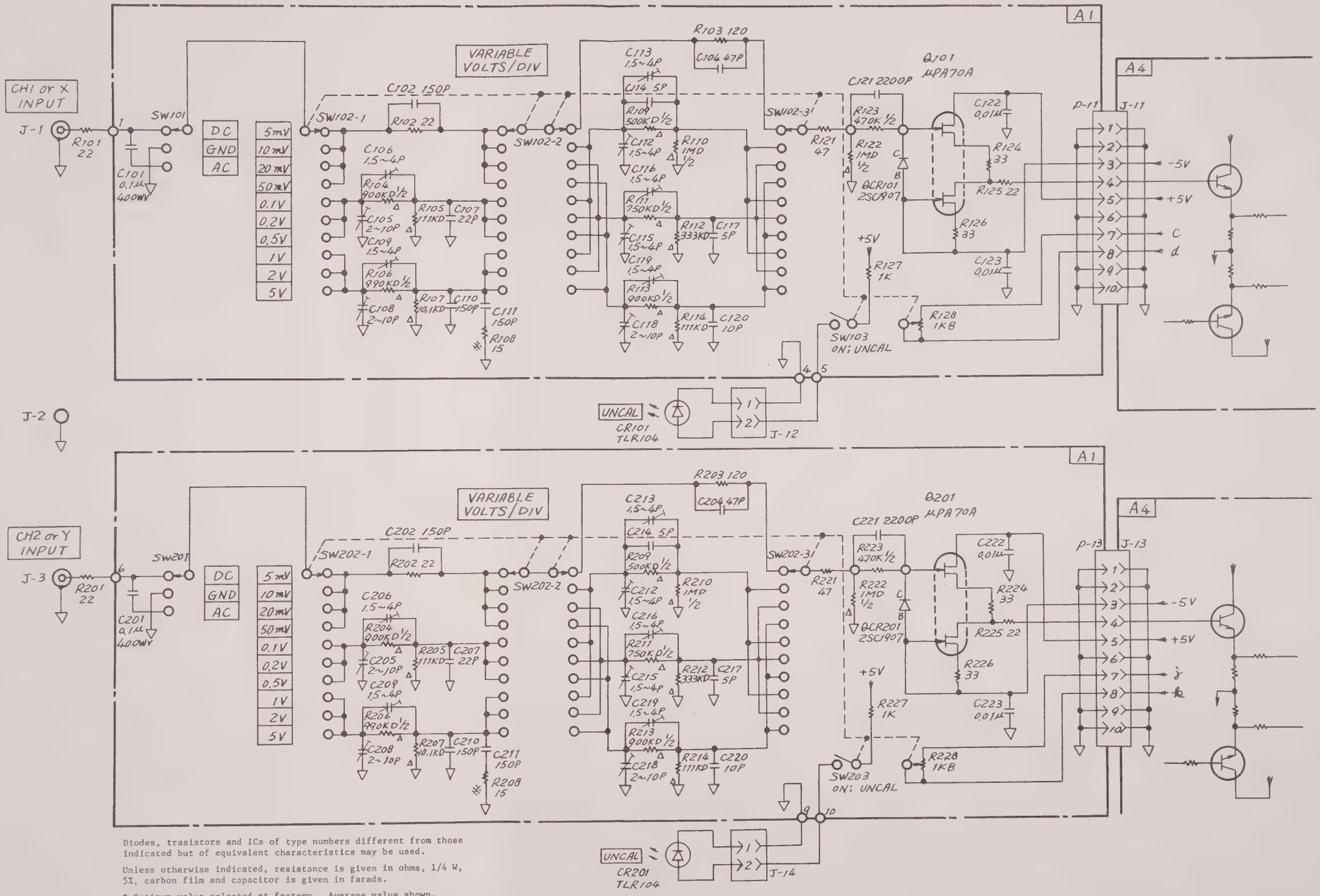



Figure 48




MODEL 5650 BLOCK DIAGRAM




Diodes, trasistors and ICs of type numbers different from those indicated but of equivalent characteristics may be used.

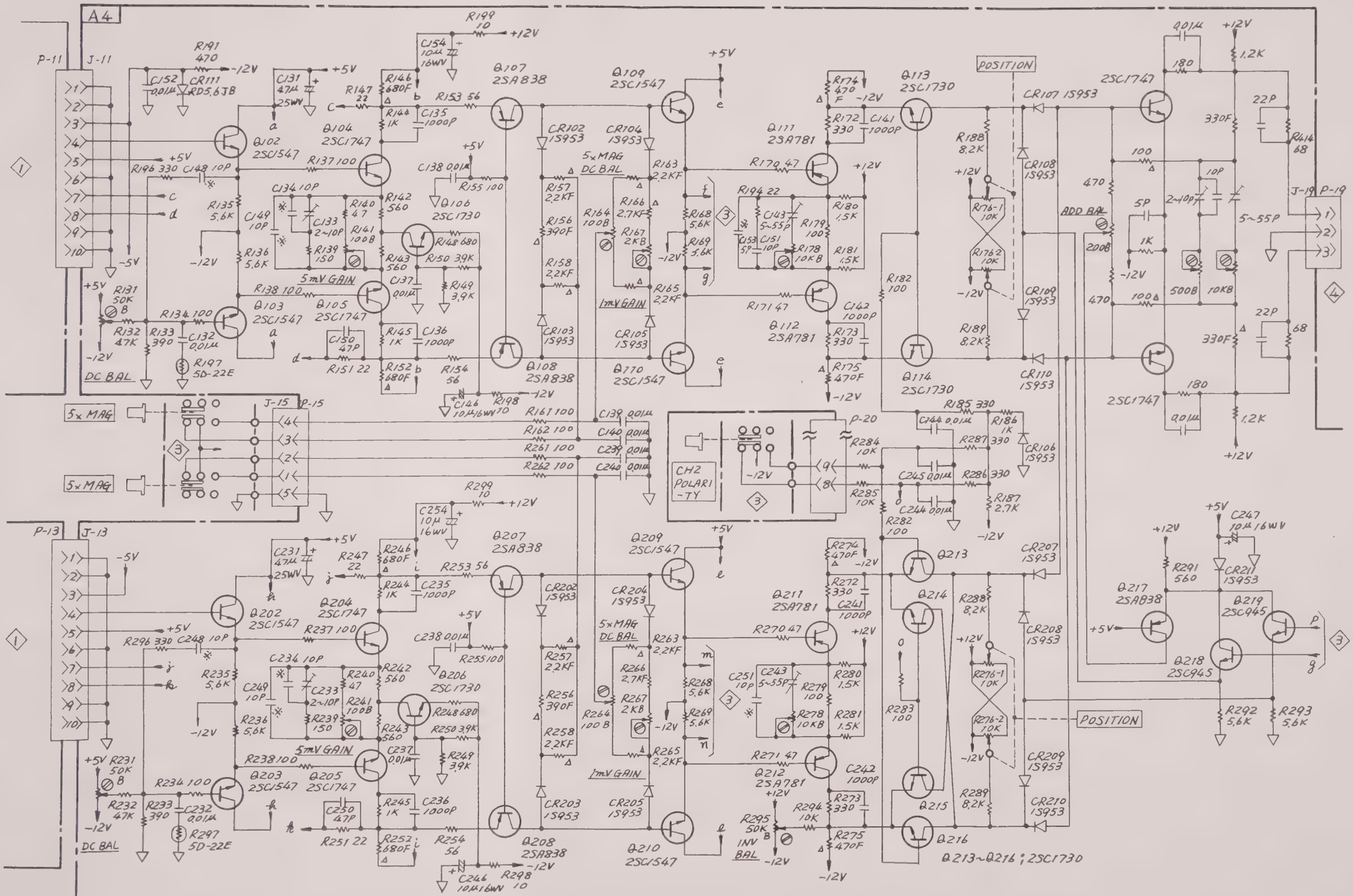
Unless otherwise indicated, resistance is given in ohms, 1/4 W, 5%, carbon film and capacitor is given in farads.

* Optimum value selected at factory. Average value shown. (Parts may be omitted.)

△ Metal film resistor. ⊘ Screwdriver adjustment.

MODEL 5650

CH1, CH2 ATT & VOLTAGE FOLLOWER ◇1




Diodes, transistors and ICs of type numbers different from those indicated but of equivalent characteristics may be used.

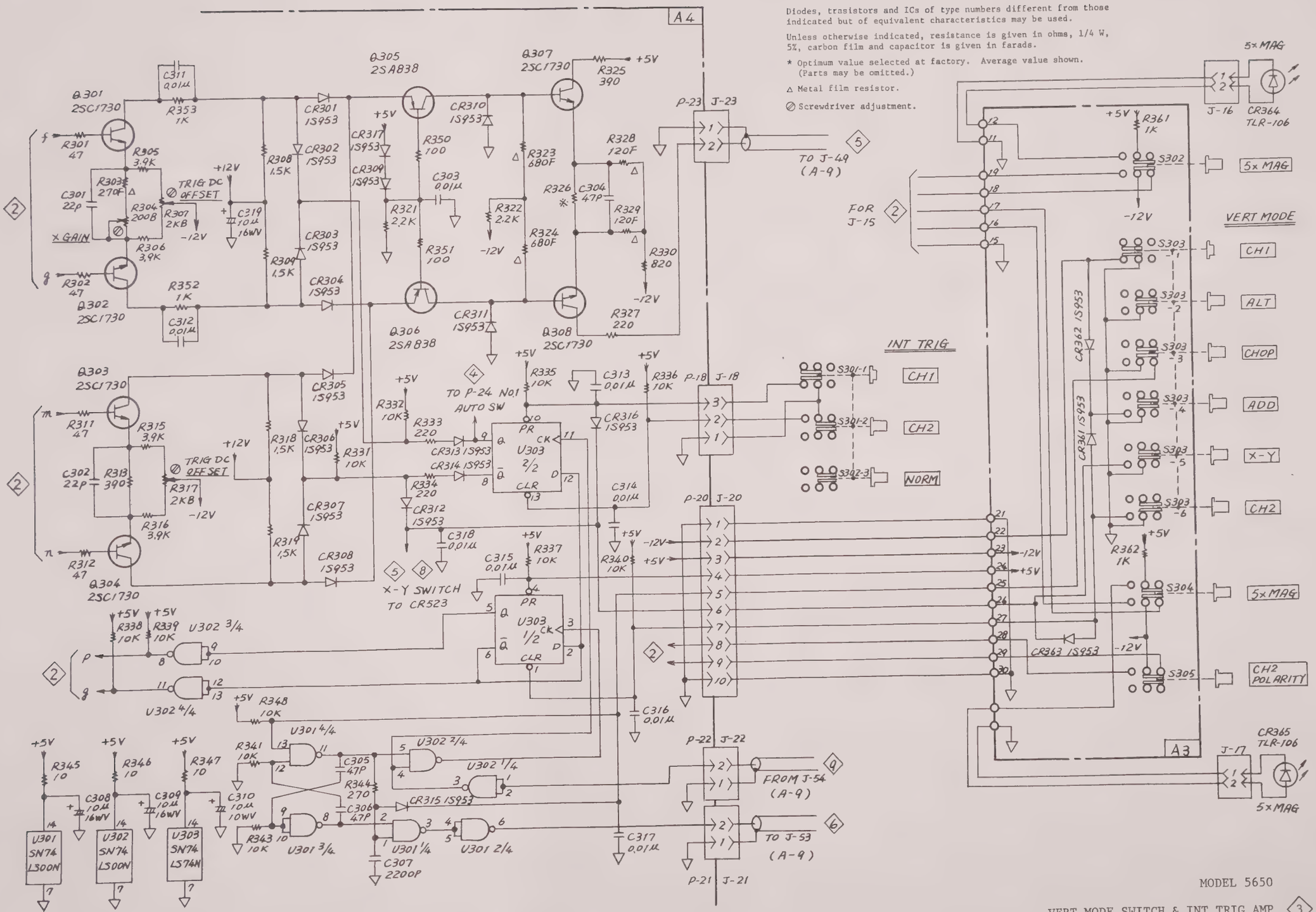
Unless otherwise indicated, resistance is given in ohms, 1/4W, 5%, carbon film and capacitor is given in farads.

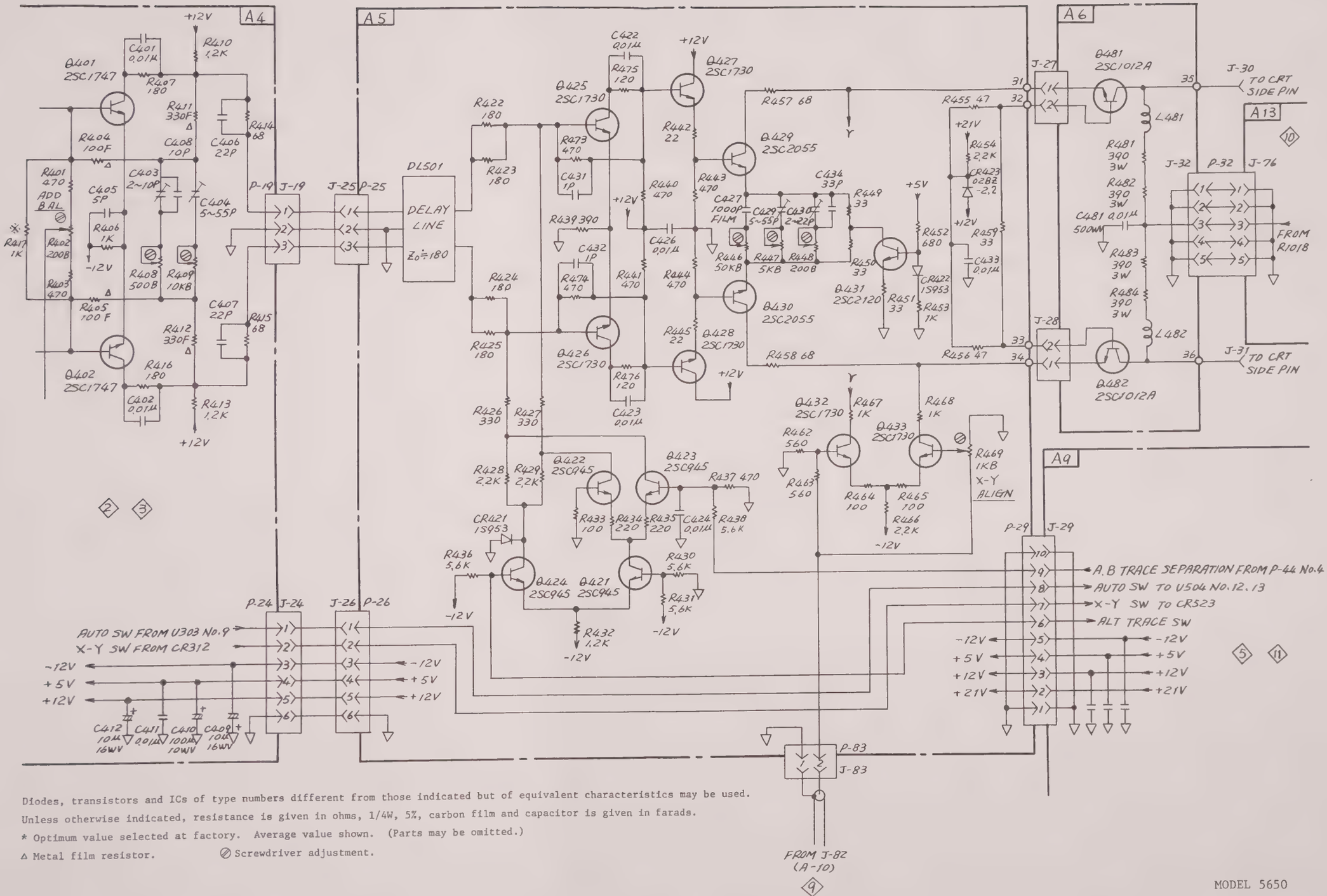
* Optimum value selected at factory. Average value shown. (Parts may be omitted.)

△ Metal film resistor. ⊘ Screwdriver adjustment.

MODEL 5650

CH1, CH2 PREAMP ◇2

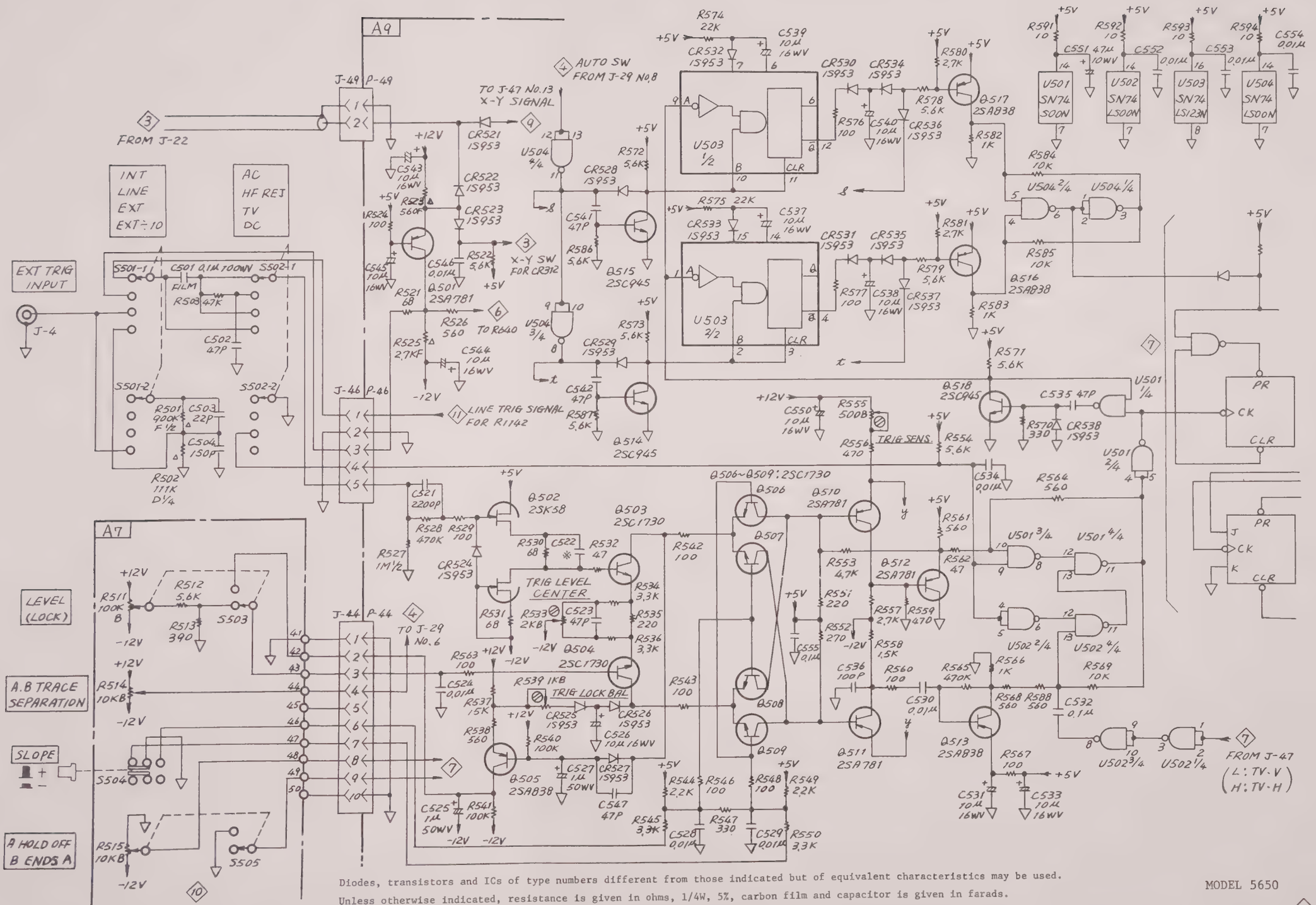

Diodes, trasistors and ICs of type numbers different from those indicated but of equivalent characteristics may be used.
Unless otherwise indicated, resistance is given in ohms, 1/4 W, 5%, carbon film and capacitor is given in farads.
* Optimum value selected at factory. Average value shown. (Parts may be omitted.)
△ Metal film resistor.
⊘ Screwdriver adjustment.
A4
A3
Q301 2SC1730
Q302 2SC1730
Q303 2SC1730
Q304 2SC1730
Q305 2SA838
Q306 2SA838
Q307 2SC1730
Q308 2SC1730
TRIG DC OFFSET
X GAIN
INT TRIG
CH1
CH2
NORM
ALT
CHOP
ADD
X-Y
5× MAG
VERT MODE
CH2 POLARITY
TO J-49 (A-9)
FROM J-54 (A-9)
TO J-53 (A-9)
TO P-24 NO.1 AUTO SW
X-Y SWITCH TO CR523
FOR J-15
U301 SN74 LS00N
U302 SN74 LS00N
U303 SN74 LS74N
MODEL 5650
VERT MODE SWITCH & INT TRIG AMP




Diodes, transistors and ICs of type numbers different from those indicated but of equivalent characteristics may be used.
Unless otherwise indicated, resistance is given in ohms, 1/4W, 5%, carbon film and capacitor is given in farads.
* Optimum value selected at factory. Average value shown. (Parts may be omitted.)
△ Metal film resistor. ⊘ Screwdriver adjustment.

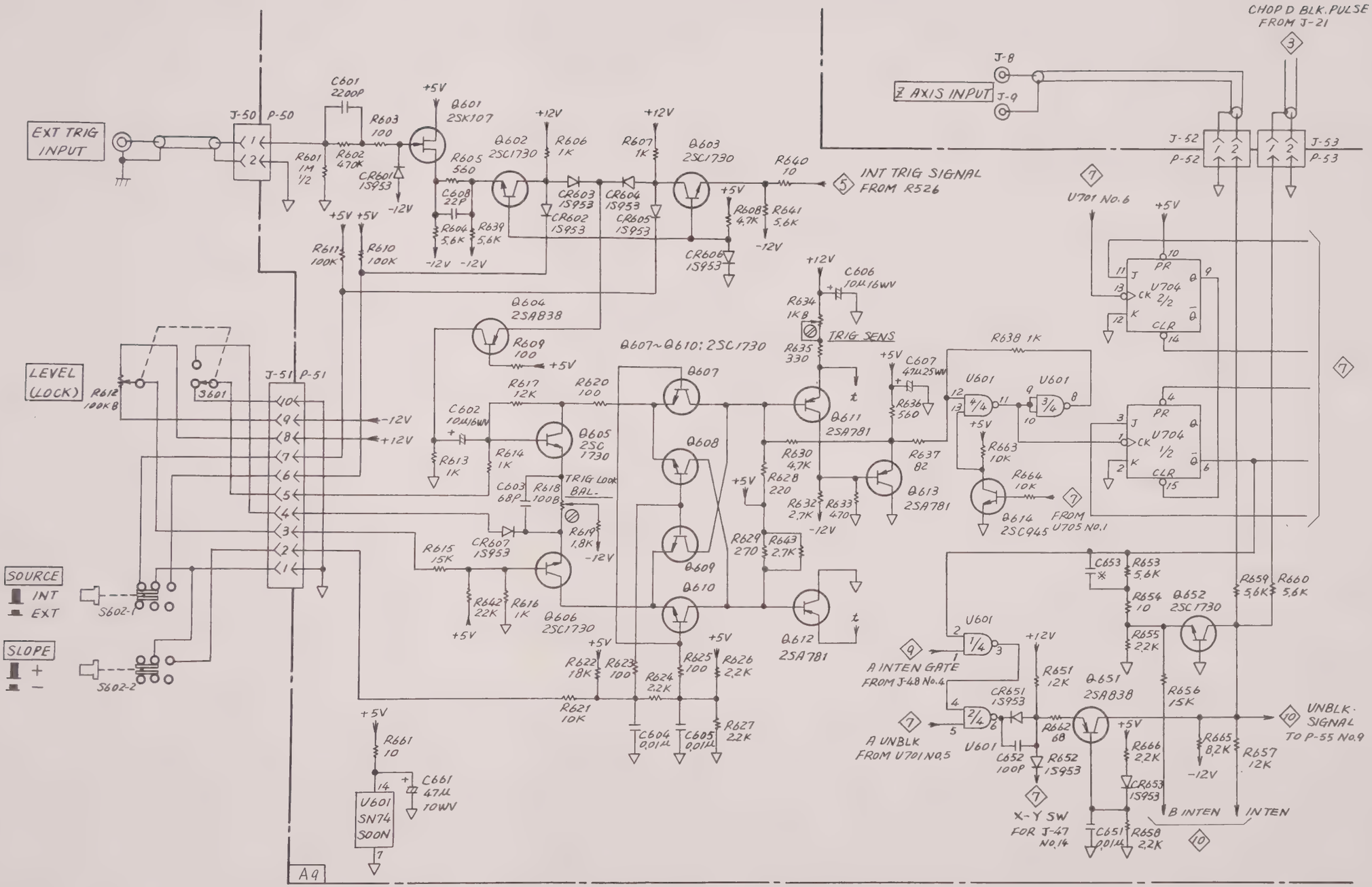
MODEL 5650

VERT MODE SWITCH & INT TRIG AMP ◇4




Diodes, transistors and ICs of type numbers different from those indicated but of equivalent characteristics may be used.
Unless otherwise indicated, resistance is given in ohms, 1/4W, 5%, carbon film and capacitor is given in farads.
* Optimum value selected at factory. Average value shown. (Parts may be omitted.)
△ Metal film resistor. ⊘ Screwdriver adjustment.

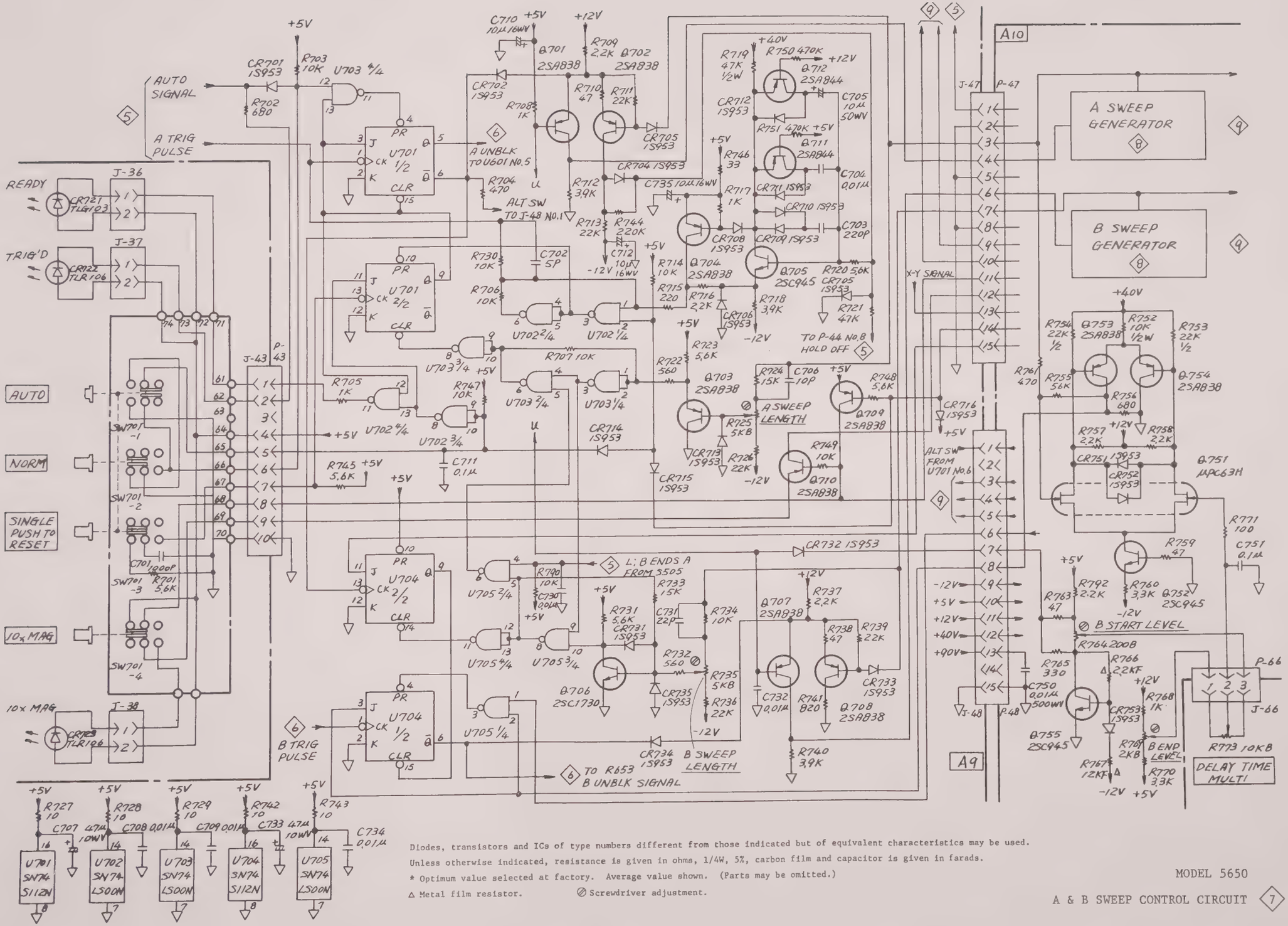
MODEL 5650
A TRIG CIRCUIT 5




Diodes, transistors and ICs of type numbers different from those indicated but of equivalent characteristics may be used.
Unless otherwise indicated, resistance is given in ohms, 1/4W, 5%, carbon film and capacitor is given in farads.
* Optimum value selected at factory. Average value shown. (Parts may be omitted.)
Δ Metal film resistor. ⊘ Screwdriver adjustment.

MODEL 5650

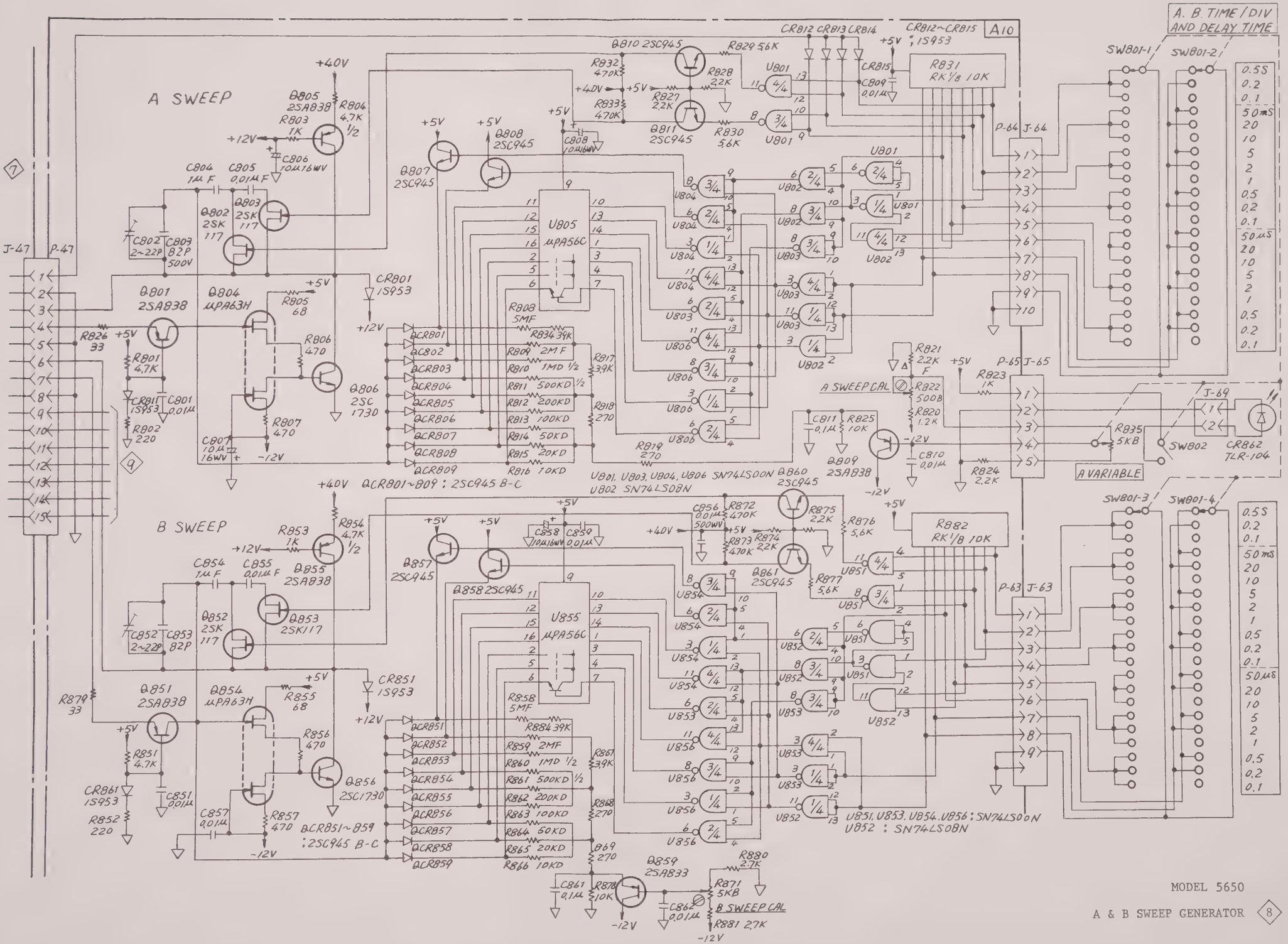
B TRIG & UNBLANKING CIRCUIT 6




Diodes, transistors and ICs of type numbers different from those indicated but of equivalent characteristics may be used.
Unless otherwise indicated, resistance is given in ohms, 1/4W, 5%, carbon film and capacitor is given in farads.
* Optimum value selected at factory. Average value shown. (Parts may be omitted.)
△ Metal film resistor. ⊘ Screwdriver adjustment.

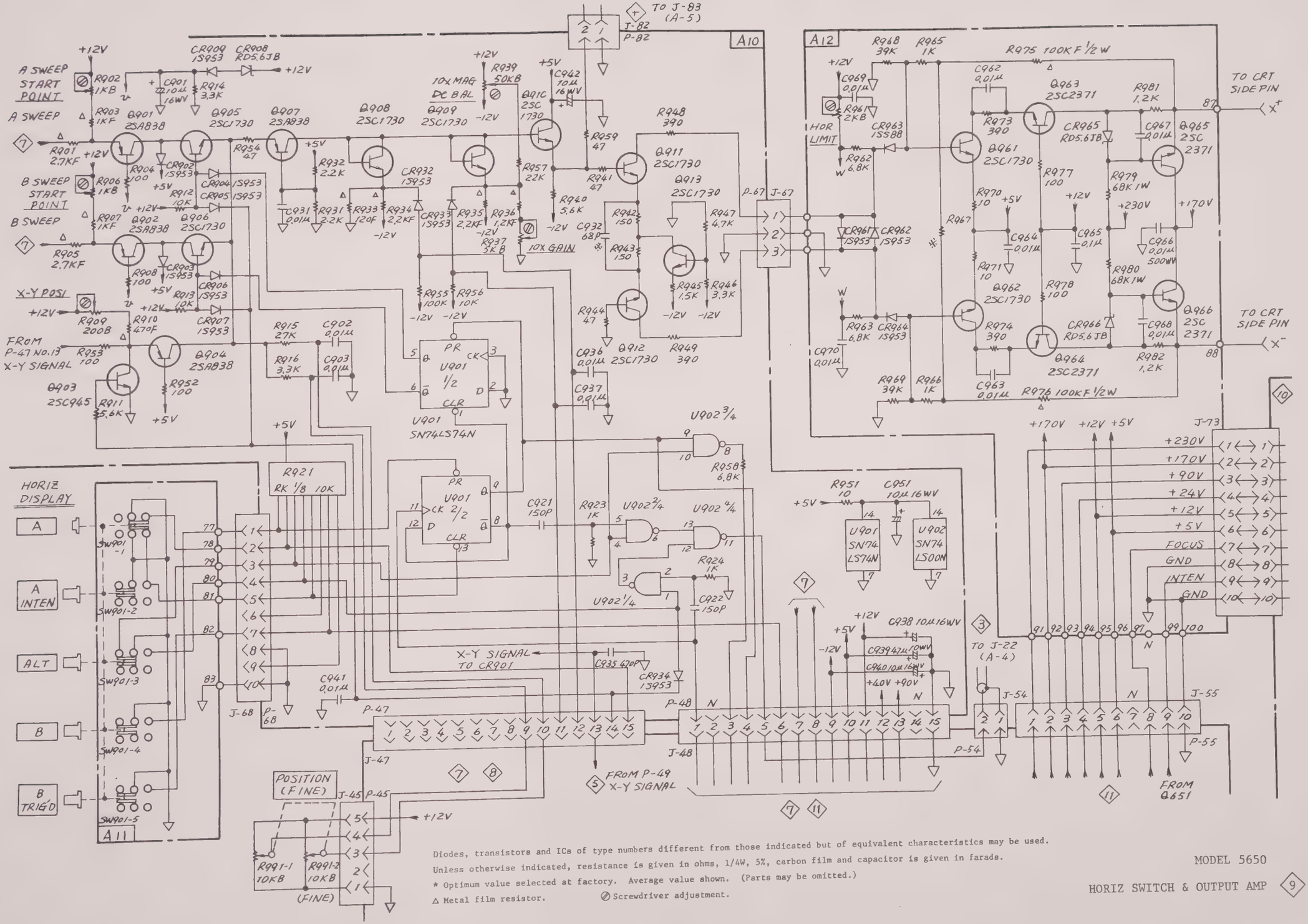
MODEL 5650

A & B SWEEP CONTROL CIRCUIT 7




MODEL 5650

A & B SWEEP GENERATOR 8




Diodes, transistors and ICs of type numbers different from those indicated but of equivalent characteristics may be used.

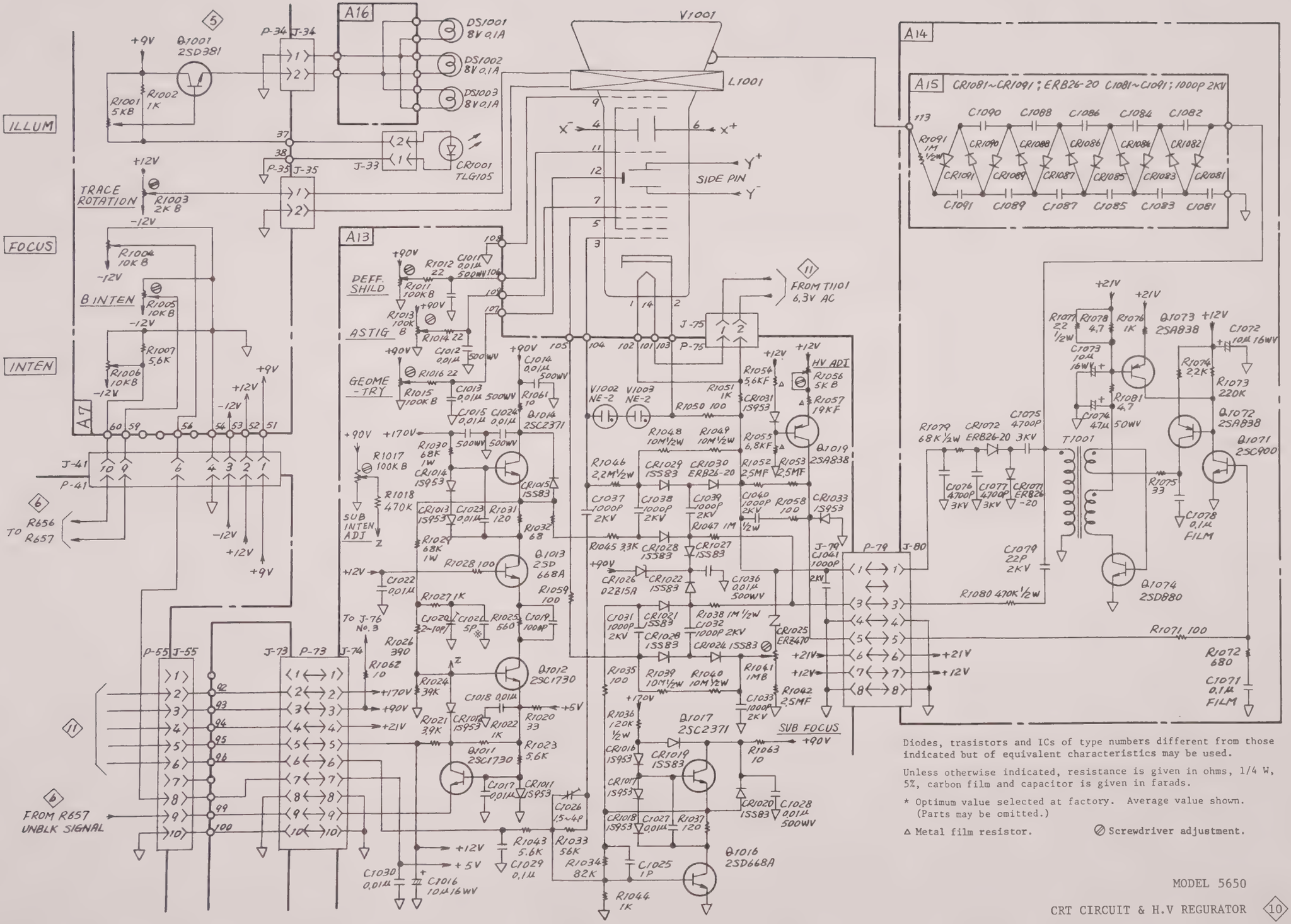
Unless otherwise indicated, resistance is given in ohms, 1/4W, 5%, carbon film and capacitor is given in farads.

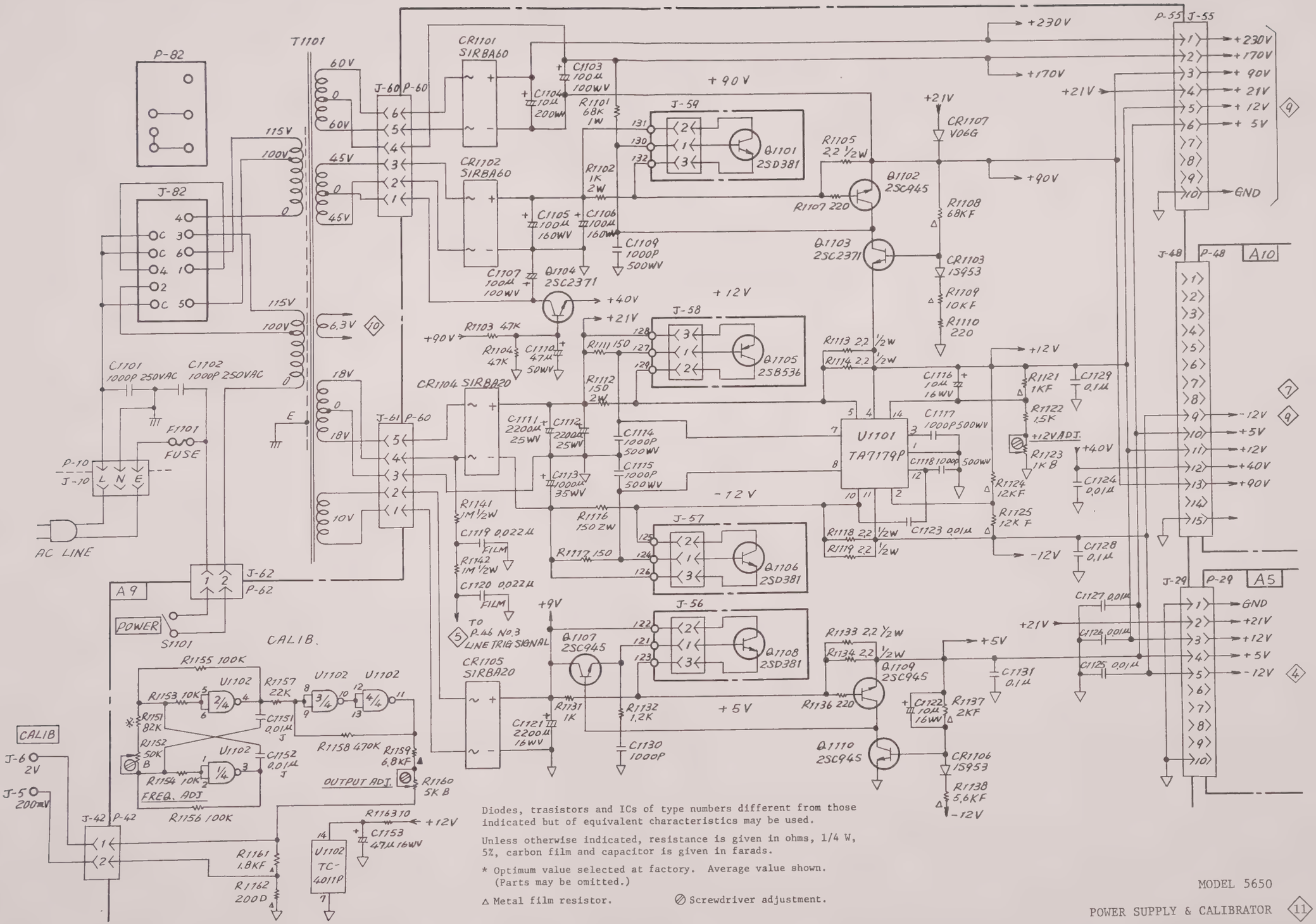
* Optimum value selected at factory. Average value shown. (Parts may be omitted.)

△ Metal film resistor. ⊘ Screwdriver adjustment.

MODEL 5650

HORIZ SWITCH & OUTPUT AMP ⟨9⟩


ILLUM
FOCUS
INTEN
TRACE ROTATION
B.INTEN
ASTIG
GEOME -TRY
DEFF. SHILD
SUB INTEN. ADJ
SIDE PIN
SUB FOCUS
HV ADJ
FROM T1101 6.3V AC
FROM R657 UNBLK SIGNAL
TO R656 TO R657
To J-76 No. 3
A13
A14
A15
A16
A7
V1001
L1001
CR1081~CR1091 ; ERB26-20
C1081~C1091 ; 1000P 2KV
Q1001 2SD381
Q1011 2SC1730
Q1012 2SC1730
Q1013 2SD 668A
Q1014 2SC2371
Q1016 2SD668A
Q1017 2SC2371
Q1019 2SA838
Q1071 2SC900
Q1072 2SA838
Q1073 2SA838
Q1074 2SD880
DS1001 8V 0.1A
DS1002 8V 0.1A
DS1003 8V 0.1A
CR1001 TLG105
T1001
FILM
Diodes, trasistors and ICs of type numbers different from those indicated but of equivalent characteristics may be used.
Unless otherwise indicated, resistance is given in ohms, 1/4 W, 5%, carbon film and capacitor is given in farads.
* Optimum value selected at factory. Average value shown. (Parts may be omitted.)
△ Metal film resistor.
Screwdriver adjustment.
MODEL 5650
CRT CIRCUIT & H.V REGURATOR
10




Diodes, trasistors and ICs of type numbers different from those indicated but of equivalent characteristics may be used.

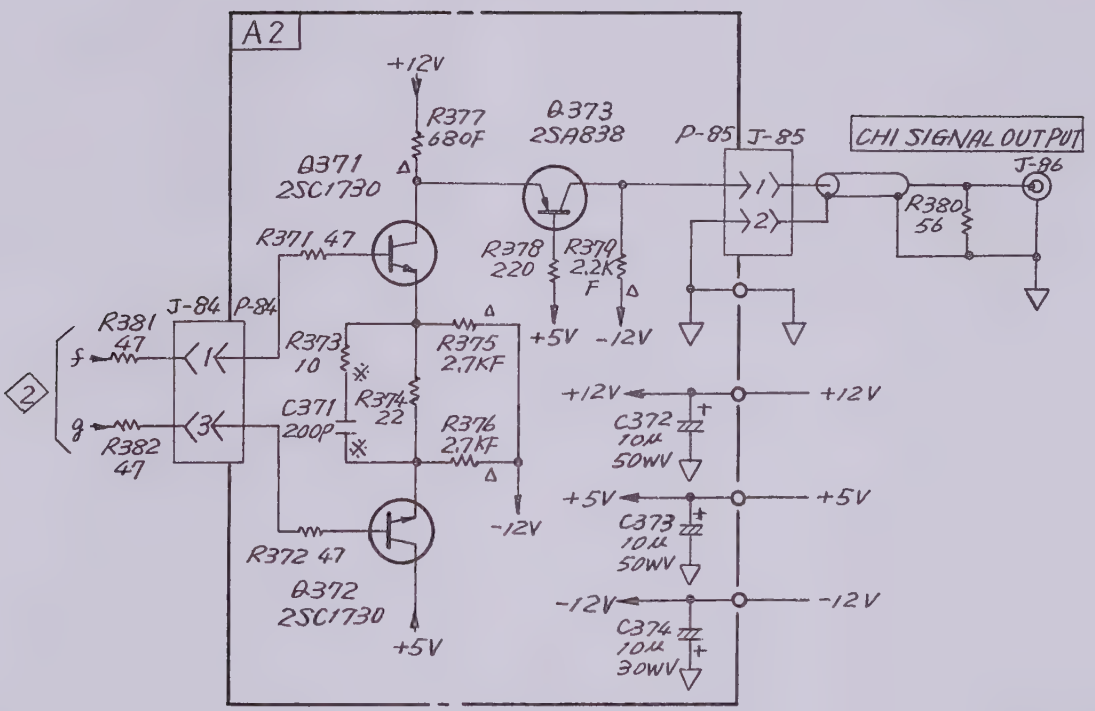
Unless otherwise indicated, resistance is given in ohms, 1/4 W, 5%, carbon film and capacitor is given in farads.

* Optimum value selected at factory. Average value shown. (Parts may be omitted.)

△ Metal film resistor. ⊘ Screwdriver adjustment.

MODEL 5650

POWER SUPPLY & CALIBRATOR 11




Diodes, trasistors and ICs of type numbers different from those indicated but of equivalent characteristics may be used.

Unless otherwise indicated, resistance is given in ohms, 1/4 W, 5%, carbon film and capacitor is given in farads.

* Optimum value selected at factory. Average value shown. (Parts may be omitted.)

△ Metal film resistor. ⊘ Screwdriver adjustment.

MODEL 5650

CH1 SIGNAL OUTPUT ◇12◇

ABBREVIATIONS

| | |
|---|---|
| CER: | ceramic |
| C FILM: | carbon film |
| C COMP: | carbon composition |
| CRT: | cathode ray tube |
| ELECT: | electrolytic |
| FET: | field effect transistor |
| FXD: | fixed |
| LED: | light emitting diode |
| M FILM: | metal film |
| M GLAZE: | metal glaze |
| M OX: | metal oxide |
| M PLSTC FILM: | metallized plastic film |
| PLSTC FILM: | plastic film |
| TANT ELECT: | tantalum electrolytic |
| VAR: | variable |
| W W: | wirewound |

| | |
|---|---|
| *: | Optimum value selected at factory. |
| | Average value shown. (Parts may be omitted.) |

| REFERENCE DESIGNATOR | KIKUSUI PARTS NO. | DESCRIPTION |
|---|---|---|
| A1 PCB-S A1 | 90-50-2010 | PC BOARD A1 VERT ATT |
| C101 | 50-87-0500 | C FXD PLSTC 0.1μF 400V |
| C102 | 52-06-2245 | C FXD CER 150PF 50V |
| C104 | 52-06-3185 | C FXD CER 47PF 500V |
| C105 | 47-10-1190 | C VAR CER 2-10PF |
| C106 | 57-10-1180 | C VAR CER 1.5-4PF |
| C107 | 52-06-3145 | C FXD CER 22PF 500V |
| C108 | 57-10-1190 | C VAR CER 2-10PF |
| C109 | 57-10-1180 | C VAR CER 1.5-4PF |
| C110 | 52-06-2245 | C FXD CER 150PF 50V |
| C111 | 52-06-2245 | C FXD CER 150PF 50V |
| C112 | 57-10-1180 | C VAR CER 1.5-4PF |
| C113 | 57-10-1180 | C VAR CER 1.5-4PF |
| C114 | 52-06-3051 | C FXD CER 5PF 500V |
| C115 | 57-10-1180 | C VAR CER 1.5-4PF |
| C116 | 57-10-1180 | C VAR CER 1.5-4PF |
| C117 | 52-06-3051 | C FXD CER 5PF 500V |
| C118 | 57-10-1190 | C VAR CER 2-10PF |
| C119 | 57-10-1180 | C VAR CER 1.5-4PF |
| C120 | 52-06-3102 | C FXD CER 10PF 500V |
| C121 | 52-01-3385 | C FXD CER 2200PF 500V |
| C122 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C123 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C201 | 50-87-0500 | C FXD PLSTC 0.1μF 400V |
| C202 | 52-06-2245 | C FXD CER 150PF 50V |
| C204 | 52-06-3185 | C FXD CER 47PF 500V |
| C205 | 57-10-1190 | C VAR CER 2-10PF |
| C206 | 57-10-1180 | C VAR CER 1.5-4PF |
| C207 | 52-06-3145 | C FXD CER 22PF 500V |
| C208 | 57-10-1190 | C VAR CER 2-10PF |
| C209 | 57010-1180 | C VAR CER 1.5-4PF |
| C210 | 52-06-2245 | C FXD CER 150PF 50V |
| C211 | 52-06-2245 | C FXD CER 150PF 50V |
| C212 | 57-10-1180 | C VAR CER 1.5-4PF |
| C213 | 57-10-1180 | C VAR CER 1.5-4PF |
| C214 | 52-06-3051 | C FXD CER 5PF 500V |
| C215 | 57-10-1180 | C VAR CER 1.5-4PF |
| C216 | 57-10-1180 | C VAR CER 1.5-4PF |
| C217 | 52-06-3051 | C FXD CER 5PF 500V |
| C218 | 57-10-1190 | C VAR CER 2-10PF |
| C219 | 57-10-1180 | C VAR CER 1.5-4PF |
| C220 | 52-06-3102 | C FXD CER 10PF 500V |
| C221 | 52-01-3385 | C FXD CER 2200PF 500V |
| C222 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C223 | 52-05-2468 | C FXD CER 0.01μF 50V |
| Q101 | 31-90-0070 | FET DUAL VGS1-VGS2=5mV μPA70A NEC |
| Q201 | 31-90-0070 | FET DUAL VGS1-VGS2=5mV μPA70A NEC |
| QCR101 | 30-31-9071 | TR SI 2SC1907 DIODE CONNECTION HITACHI |
| QCR201 | 30-31-9071 | TR SI 2SC1907 DIODE CONNECTION HITACHI |
| R102 | 40-27-0222 | R FXD C FILM 22Ω 5% 1/4W |
| R103 | 40-27-1122 | R FXD C FILM 120Ω 5% 1/4W |
| R104 | 42-73-4900 | R FXD M FILM 900KΩ 0.5% 1/2W |
| R105 | 42-71-4111 | R FXD M FILM 111KΩ 0.5% 1/4W |
| R106 | 42-73-4990 | R FXD M FILM 990KΩ 0.5% 1/2W |
| R107 | 42-71-3101 | R FXD M FILM 10.1KΩ 0.5% 1/4W |
| R108* | 40-27-0152 | R FXD C FILM 15Ω 5% 1/4W |
| R109 | 42-73-4500 | R FXD M FILM 500KΩ 0.5% 1/2W |
| R110 | 42-73-5100 | R FXD M FILM 1MΩ 0.5% 1/2W |
| R111 | 42-73-4750 | R FXD M FILM 750KΩ 0.5% 1/2W |
| R112 | 42-71-4333 | R FXD M FILM 333KΩ 0.5% 1/4W |
| R113 | 42-73-4900 | R FXD M FILM 900KΩ 0.5% 1/2W |
| R114 | 42-71-4111 | R FXD M FILM 111KΩ 0.5% 1/4W |
| R121 | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| R122 | 42-73-5100 | R FXD M FILM 1MΩ 0.5% 1/2W |
| R123 | 40-37-4471 | R FXD C FILM 470KΩ 5% 1/2W |
| R124 | 40-27-0332 | R FXD C FILM 33Ω 5% 1/4W |
| R125 | 40-27-0222 | R FXD C FILM 22Ω 5% 1/4W |
| R126 | 40-27-0332 | R FXD C FILM 33Ω 5% 1/4W |
| R127 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| R128 (WITH SW103) | 45-01-0400 | R VAR C COMP 1KΩ WITH SW |
| R202 | 40-27-0222 | R FXD C FILM 22Ω 5% 1/4W |
| R203 | 40-27-1122 | R FXD C FILM 120Ω 5% 1/4W |
| R204 | 42-73-4900 | R FXD M FILM 900KΩ 0.5% 1/2W |
| R205 | 42-71-4111 | R FXD M FILM 111KΩ 0.5% 1/4W |
| R206 | 42-73-4990 | R FXD M FILM 990KΩ 0.5% 1/2W |
| R207 | 42-71-3101 | R FXD M FILM 10.1KΩ 0.5% 1/4W |
| R208* | 40-27-0152 | R FXD C FILM 15Ω 5% 1/4W |
| R209 | 42-73-4500 | R FXD M FILM 500KΩ 0.5% 1/2W |
| R210 | 42-73-5100 | R FXD M FILM 1MΩ 0.5% 1/2W |
| R211 | 42-73-4750 | R FXD M FILM 750KΩ 0.5% 1/2W |
| R212 | 42-71-4333 | R FXD M FILM 333KΩ 0 5% 1/4W |
| R213 | 42-73-4900 | R FXD M FILM 900KΩ 0.5% 1/2W |
| R214 | 42-71-4111 | R FXD M FILM 111KΩ 0.5% 1/4W |
| R221 | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| R222 | 42-73-5100 | R FXD M FILM 1MΩ 0.5% 1/2W |
| R223 | 40-37-4471 | R FXD C FILM 470KΩ 5% 1/2W |
| R224 | 40-27-0332 | R FXD C FILM 33Ω 5% 1/4W |
| R225 | 40-27-0222 | R FXD C FILM 22Ω 5% 1/4W |
| R226 | 40-27-0332 | R FXD C FILM 33Ω 5% 1/4W |
| R227 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| R228 (WITH SW203) | 45-01-0400 | R VAR C COMP 1KΩ WITH SW |
| SW101 | 82-71-0050 | SW LEVER (AC/DC/GND) J19-123 |
| SW102 | 80-10-3020 | SW ROTARY (VOLT/DIV) |
| SW103 | - | SEE R128 (A PART OF R128) |
| SW201 | 82-71-0050 | SW LEVER (AC/DC/GND) J19-123 |
| SW202 | 80-10-3020 | SW ROTARY (VOLT/DIV) |
| SW203 | - | SEE R228 (A PART OF R228) |

| REFERENCE DESIGNATOR | KIKUSUI PARTS NO. | DESCRIPTION |
|---|---|---|
| A2 PCB-S A2 | 90-50-2021 | PC BOARD-A2 CH1 SIGNAL OUT |
| C371* | 50-76-2020 | C FXD PLSTC 300PF 250V |
| C372 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C373 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C374 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C375* | 52-06-2265 | C FXD CER 220PF 50V |
| Q371 | 30-31-7301 | TR SI NPN 2SC1730-L NEC |
| Q372 | 30-31-7301 | TR SI NPN 2SC1730-L NEC |
| Q373 | 30-10-8381 | TR SI PNP 2SA838-B MATSUSHITA |
| R371 | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| R372 | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| R373* | 40-27-0102 | R FXD C FILM 10Ω 5% 1/4W |
| R374 | 40-27-0222 | R FXD C FILM 22Ω 5% 1/4W |
| R375 | 40-72-2270 | R FXD M FILM 2.7KΩ 1% 1/4W |
| R376 | 40-72-2270 | R FXD M FILM 2.7KΩ 1% 1/4W |
| R377 | 42-72-1680 | R FXD M FILM 680Ω 1% 1/4W |
| R378 | 40-27-1222 | R FXD C FILM 220Ω 5% 1/4W |
| R379 | 42-72-2220 | R FXD M FILM 2.2KΩ 1% 1/4W |
| A3 PCB-S A3 | 90-50-2030 | PC BOARD - A3 VERT MODE SW |
| CR361 | 32-11-5880 | DIODE SI 1S1588 TOSHIBA |
| CR362 | 32-11-5880 | DIODE SI 1S1588 TOSHIBA |
| CR363 | 32-11-5880 | DIODE SI 1S1588 TOSHIBA |
| R361 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| R362 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| S302 | 81-01-0300 | SW PUSH KSD1-2-0 ILDC |
| S303 | 81-06-0030 | SW PUSH KSD6-12-10 ILDC |
| S304 | 81-01-0360 | SW PUSH SUB12 NO 348004365 |
| S305 | 81-01-0360 | SW PUSH SUB12 NO 348004365 |
| A4 PCB-D A4 | 90-50-2040 | PC BOARD - A4 VERT PREAMP |
| C131 | 54-00-0114 | C FXD ELECT 47μF 25V |
| C132 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C133 | 57-10-1190 | C VAR CER 2-10PF |
| C134* | 52-06-3102 | C FXD CER 10PF 500V |
| C135 | 50-01-3345 | C FXD CER 1000PF 500V |
| C136 | 50-01-3345 | C FXD CER 1000PF 500V |
| C137 | 42-05-2468 | C FXD CER 0.01μF 50V |
| C138 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C139 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C140 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C141 | 52-01-3345 | C FXD CER 1000PF 500V |
| C142 | 52-01-3345 | C FXD CER 1000PF 500V |
| C143 | 57-10-1140 | C VAR CER 5-55PF |
| C144 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C146 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C148* | 52-06-3102 | C FXD CER 10PF 500V |
| C149* | 52-06-3102 | C FXD CER 10PF 500V |
| C150 | 52-06-3185 | C FXD CER 47PF 500V |
| C151* | 52-06-3102 | C FXD CER 10PF 500V |
| C152 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C153* | 52-06-3051 | C FXD CER 5PF 500V |
| C154 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C231 | 54-00-0114 | C FXD ELECT 47μF 25V |
| C232 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C233 | 57-10-1190 | C VAR CER 2-10PF |
| C234* | 52-06-3102 | C FXD CER 10PF 500V |
| C235 | 50-01-3345 | C FXD CER 1000PF 500V |
| C236 | 50-01-3345 | C FXD CER 1000PF 500V |
| C237 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C238 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C239 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C240 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C241 | 52-01-3345 | C FXD CER 1000PF 500V |
| C242 | 52-01-3345 | C FXD CER 1000PF 500V |
| C243 | 57-10-1140 | C VAR CER 5-55PF |
| C244 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C245 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C246 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C247 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C248* | 52-06-3102 | C FXD CER 10PF 500V |
| C249* | 52-06-3102 | C FXD CER 10PF 500V |
| C250 | 52-06-3185 | C FXD CER 47PF 500V |
| C251* | 52-06-3102 | C FXD CER 10PF 500V |
| C254 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C301 | 52-06-3145 | C FXD CER 22PF 500V |
| C302 | 52-06-3145 | C FXD CER 22PF 500V |
| C303 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C304 | 52-06-3185 | C FXD CER 47PF 500V |
| C305 | 52-06-3185 | C FXD CER 47PF 500V |
| C306 | 52-06-3185 | C FXD CER 47PF 500V |
| C307 | 52-01-3385 | C FXD CER 2200PF 500V |
| C308 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C309 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C310 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C311 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C312 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C313 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C314 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C315 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C316 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C317 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C318 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C319 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C401 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C402 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C403 | 57-10-1190 | C VAR CER 2-10PF |
| C404 | 57-10-1140 | C VAR CER 5-55PF |
| C405 | 52-06-3051 | C FXD CER 5PF 500V |
| C406 | 52-06-3145 | C FXD CER 22PF 500V |
| C407 | 52-06-3145 | C FXD CER 22PF 500V |
| C408 | 52-06-3102 | C FXD CER 10PF 500V |

| REFERENCE DESIGNATOR | KIKUSUI PARTS NO | DESCRIPTION |
|---|---|---|
| A4 C409 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C410 | 54-00-0121 | C FXD ELECT 100μF 25V |
| C411 | 54-05-2468 | C FXD CER 0.01μF 50V |
| C412 | 52-00-0311 | C FXD ELECT 10μF 50V |
| CR102-CR110 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR111 | 32-91-1800 | DIODE ZENER RD5.6JB NEC |
| CR202-CR205 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR207-CR211 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR301-CR317 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| Q102 | 30-31-5470 | TR Si NPN 2SC1547 MATSUSHITA |
| Q103 | 30-31-5470 | TR Si NPN 2SC1547 MATSUSHITA |
| Q104 | 30-31-7470 | TR Si NPN 2SC1747 HITACHI |
| Q105 | 30-31-7470 | TR Si NPN 2SC1747 HITACHI |
| Q106 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q107 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q108 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q109 | 30-31-5470 | TR Si NPN 2SC1547 MATSUSHITA |
| Q110 | 30-31-5470 | TR Si NPN 2SC1547 MATSUSHITA |
| Q111 | 30-10-7810 | TR Si PNP 2SA781 HITACHI |
| Q112 | 30-10-7810 | TR Si PNP 2SA781 HITACHI |
| Q113 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q114 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q202 | 30-31-5470 | TR Si NPN 2SC1547 MATSUSHITA |
| Q203 | 30-31-5470 | TR Si NPN 2SC1547 MATSUSHITA |
| Q204 | 30-31-7470 | TR Si NPN 2SC1747 HITACHI |
| Q205 | 30-31-7470 | TR Si NPN 2SC1747 HITACHI |
| Q206 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q207 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q208 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q209 | 30-31-5470 | TR Si NPN 2SC1547 MATSUSHITA |
| Q210 | 30-31-5470 | TR Si NPN 2SC1547 MATSUSHITA |
| Q211 | 30-10-7810 | TR Si PNP 2SA781 HITACHI |
| Q212 | 30-10-7810 | TR Si PNP 2SA781 HITACHI |
| Q213 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q214 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q215 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q216 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q217 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q218 | 30-30-9451 | TR Si NPN 2SC945-Q NEC |
| Q219 | 30-30-9451 | TR Si NPN 2SC945-Q NEC |
| Q301 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q302 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q303 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q304 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q305 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q306 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q307 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q308 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q401 | 30-31-7470 | TR Si NPN 2SC1747 HITACHI |
| Q402 | 30-31-7470 | TR Si NPN 2SC1747 HITACHI |
| R131 | 48-29-3500 | R VAR M FILM 50KΩ |
| R132 | 40-27-3472 | R FXD C FILM 47KΩ 5% 1/4W |
| R133 | 40-27-1392 | R FXD C FILM 390Ω 5% 1/4W |
| R134 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R135 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R136 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R137 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R138 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R139 | 40-27-1152 | R FXD C FILM 150Ω 5% 1/4W |
| R140 | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| R141 | 48-29-1100 | R VAR M FILM 100Ω |
| R142 | 40-27-1562 | R FXD C FILM 560Ω 5% 1/4W |
| R143 | 40-27-1562 | R FXD C FILM 560Ω 5% 1/4W |
| R144 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| R145 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| R146 | 42-72-1680 | R FXD M FILM 680Ω 1% 1/4W |
| R147 | 40-27-0222 | R FXD C FILM 22Ω 5% 1/4W |
| R148 | 40-27-1682 | R FXD C FILM 680Ω 5% 1/4W |
| R149 | 40-27-2392 | R FXD C FILM 3.9KΩ 5% 1/4W |
| R150 | 40-27-2392 | R FXD C FILM 3.9KΩ 5% 1/4W |
| R151 | 40-27-0222 | R FXD C FILM 22Ω 5% 1/4W |
| R152 | 42-72-1680 | R FXD M FILM 680Ω 1% 1/4W |
| R153 | 40-27-0562 | R FXD C FILM 56Ω 5% 1/4W |
| R154 | 40-27-0562 | R FXD C FILM 56Ω 5% 1/4W |
| R155 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R156 | 42-72-1390 | R FXD M FILM 390Ω 1% 1/4W |
| R157 | 42-72-2220 | R FXD M FILM 2.2KΩ 1% 1/4W |
| R158 | 42-72-2220 | R FXD M FILM 2.2KΩ 1% 1/4W |
| R161 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R162 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R163 | 42-72-2220 | R FXD M FILM 2.2KΩ 1% 1/4W |
| R164 | 48-12-1101 | R VAR M FILM 100Ω |
| R165 | 42-72-2220 | R FXD M FILM 2.2KΩ 1% 1/4W |
| R166 | 42-72-2270 | R FXD M FILM 2.7KΩ 1% 1/4W |
| R167 | 48-29-2200 | R VAR M FILM 2KΩ |
| R168 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R169 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R170 | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| R171 | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| R172 | 40-27-1332 | R FXD C FILM 330Ω 5% 1/4W |
| R173 | 40-27-1332 | R FXD C FILM 330Ω 5% 1/4W |
| R174 | 42-72-1470 | R FXD M FILM 470Ω 1% 1/4W |
| R175 | 42-72-1470 | R FXD M FILM 470Ω 1% 1/4W |
| R176 | 45-02-0210 | R VAR C FILM 10KΩ+10KΩ WITH SW |
| R178 | 48-29-3100 | R VAR M FILM 10KΩ |
| R179 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |

| REFERENCE DESIGNATOR | KIKUSUI PARTS NO | DESCRIPTION |
|---|---|---|
| A4 R180 | 40-27-2152 | R FXD C FILM 1.5KΩ 5% 1/4W |
| R181 | 40-27-2152 | R FXD C FILM 1.5KΩ 5% 1/4W |
| R182 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R185 | 40-27-1332 | R FXD C FILM 330Ω 5% 1/4W |
| R186 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| R187 | 40-27-2272 | R FXD C FILM 2.7KΩ 5% 1/4W |
| R188 | 40-27-2822 | R FXD C FILM 8.2KΩ 5% 1/4W |
| R189 | 40-27-2822 | R FXD C COMP 8.2KΩ 5% 1/4W |
| R191 | 40-27-1472 | R FXD C FILM 470Ω 5% 1/4W |
| R192* | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| R193* | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| R194* | 40-27-0222 | R FXD C FILM 22Ω 5% 1/4W |
| R196 | 40-27-1332 | R FXD C FILM 330Ω 5% 1/4W |
| R197 | 38-00-0000 | THERMISTOR 250Ω at 25°C α=-3.5%/C° 5D-22E SHIBAURA |
| R198 | 40-27-0102 | R FXD C FILM 10Ω 5% 1/4W |
| R199 | 40-27-0102 | R FXD C FILM 10Ω 5% 1/4W |
| R231 | 48-29-3500 | R VAR M FILM 50KΩ |
| R232 | 40-27-3472 | R FXD C FILM 47KΩ 5% 1/4W |
| R233 | 40-27-1392 | R FXD C FILM 390Ω 5% 1/4W |
| R234 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R235 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R236 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R237 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R238 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R239 | 40-27-1152 | R FXD C FILM 150Ω 5% 1/4W |
| R240 | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| R241 | 48-29-1100 | R VAR M FILM 100Ω |
| R242 | 40-27-1562 | R FXD C FILM 560Ω 5% 1/4W |
| R243 | 40-27-1562 | R FXD C FILM 560Ω 5% 1/4W |
| R244 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| R245 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| R246 | 42-72-1680 | R FXD M FILM 680Ω 1% 1/4W |
| R247 | 40-27-0222 | R FXD C FILM 22Ω 5% 1/4W |
| R248 | 40-27-1682 | R FXD C FILM 680Ω 5% 1/4W |
| R249 | 40-27-2392 | R FXD C FILM 3.9KΩ 5% 1/4W |
| R250 | 40-27-2392 | R FXD C FILM 3.9KΩ 5% 1/4W |
| R251 | 40-27-0222 | R FXD C FILM 22Ω 5% 1/4W |
| R252 | 42-72-1680 | R FXD M FILM 680Ω 1% 1/4W |
| R253 | 40-27-0562 | R FXD C FILM 56Ω 5% 1/4W |
| R254 | 40-27-0562 | R FXD C FILM 56Ω 5% 1/4W |
| R255 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R256 | 42-72-1390 | R FXD M FILM 390Ω 1% 1/4W |
| R257 | 42-72-2220 | R FXD M FILM 2.2KΩ 1% 1/4W |
| R258 | 42-72-2220 | R FXD M FILM 2.2KΩ 1% 1/4W |
| R261 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R262 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R263 | 42-72-2220 | R FXD M FILM 2.2KΩ 1% 1/4W |
| R264 | 48-29-1100 | R VAR M FILM 100Ω |
| R265 | 42-72-2220 | R FXD M FILM 2.2KΩ 1% 1/4W |
| R266 | 42-72-2270 | R FXD M FILM 2.7KΩ 1% 1/4W |
| R267 | 48-29-2200 | R VAR M FILM 2KΩ |
| R268 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R269 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R270 | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| R271 | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| R272 | 40-27-1332 | R FXD C FILM 330Ω 5% 1/4W |
| R273 | 40-27-1332 | R FXD C FILM 330Ω 5% 1/4W |
| R274 | 42-72-1470 | R FXD M FILM 470Ω 1% 1/4W |
| R275 | 42-72-1470 | R FXD M FILM 470Ω 1% 1/4W |
| R276 | 45-02-0210 | R VAR C FILM 10KΩ+10KΩ WITH SW |
| R278 | 48-29-3100 | R VAR M FILM 10KΩ |
| R279 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R280 | 40-27-2152 | R FXD C FILM 1.5KΩ 5% 1/4W |
| R281 | 40-27-2152 | R FXD C FILM 1.5KΩ 5% 1/4W |
| R282 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R283 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R284 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| R285 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| R286 | 40-27-1332 | R FXD C FILM 330Ω 5% 1/4W |
| R287 | 40-27-1332 | R FXD C FILM 330Ω 5% 1/4W |
| R288 | 40-27-2822 | R FXD C FILM 8.2KΩ 5% 1/4W |
| R289 | 40-27-2822 | R FXD C COMP 8.2KΩ 5% 1/4W |
| R291 | 40-27-1562 | R FXD C FILM 560Ω 5% 1/4W |
| R292 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R293 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R294 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| R295 | 48-29-3500 | R VAR M FILM 50KΩ |
| R296 | 40-27-1332 | R FXD C FILM 330Ω 5% 1/4W |
| R297 | 38-00-0000 | THERMISTOR 250Ω at 25°C α=-3.5%/C° 5D-22E SHIBAURA |
| R298 | 40-27-0102 | R FXD C FILM 10Ω 5% 1/4W |
| R299 | 40-27-0102 | R FXD C FILM 10Ω 5% 1/4W |
| R301 | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| R302 | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| R303 | 40-72-1270 | R FXD M FILM 270Ω 1% 1/4W |
| R304 | 48-29-1200 | R VAR M FILM 200Ω |
| R305 | 40-27-2392 | R FXD C FILM 3.9KΩ 5% 1/4W |
| R306 | 40-27-2392 | R FXD C FILM 3.9KΩ 5% 1/4W |
| R307 | 48-29-2200 | R VAR M FILM 2KΩ |
| R308 | 40-27-2152 | R FXD C FILM 1.5KΩ 5% 1/4W |
| R309 | 40-27-2152 | R FXD C FILM 1.5KΩ 5% 1/4W |
| R311 | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| R312 | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| R313 | 40-27-1392 | R FXD C FILM 390Ω 5% 1/4W |
| R315 | 40-27-2392 | R FXD C FILM 3.9KΩ 5% 1/4W |
| R316 | 40-27-2392 | R FXD C FILM 3.9KΩ 5% 1/4W |
| R317 | 48-29-2200 | R VAR M FILM 2KΩ |
| R318 | 40-27-2152 | R FXD C FILM 1.5KΩ 5% 1/4W |
| R319 | 40-27-2152 | R FXD C FILM 1.5KΩ 5% 1/4W |
| R321 | 40-27-2222 | R FXD C FILM 2.2KΩ 5% 1/4W |
| R322 | 40-27-2222 | R FXD C FILM 2.2KΩ 5% 1/4W |
| R323 | 42-72-1680 | R FXD M FILM 680Ω 1% 1/4W |
| R324 | 42-72-1680 | R FXD M FILM 680Ω 1% 1/4W |
| R325 | 40-27-1392 | R FXD C FILM 390Ω 5% 1/4W |

| REFERENCE DESIGNATOR | KIKUSUI PARTS NO. | DESCRIPTION |
|---|---|---|
| A4 R327 | 40-27-1222 | R FXD C FILM 220Ω 5% 1/4W |
| R328 | 42-72-1120 | R FXD M FILM 120Ω 1% 1/4W |
| R329 | 42-72-1120 | R FXD M FILM 120Ω 1% 1/4W |
| R330 | 40-27-1822 | R FXD C FILM 820Ω 5% 1/4W |
| R331 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| R332 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| R333 | 40-27-1222 | R FXD C FILM 220Ω 5% 1/4W |
| R334 | 40-27-1222 | R FXD C FILM 220Ω 5% 1/4W |
| R335 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| R336 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| R337 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| R338 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| R339 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| R340 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| R341 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| R343 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| R344 | 40-27-1272 | R FXD C FILM 270Ω 5% 1/4W |
| R345 | 40-27-0102 | R FXD C FILM 10Ω 5% 1/4W |
| R346 | 40-27-0102 | R FXD C FILM 10Ω 5% 1/4W |
| R347 | 40-27-0102 | R FXD C FILM 10Ω 5% 1/4W |
| R348 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| R350 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R351 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R352 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| R353 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| R401 | 40-27-1472 | R FXD C FILM 470Ω 5% 1/4W |
| R402 | 48-29-1200 | R VAR M FILM 200Ω |
| R403 | 40-27-1472 | R FXD C FILM 470Ω 5% 1/4W |
| R404 | 42-72-1100 | R FXD M FILM 100Ω 1% 1/4W |
| R405 | 42-72-1100 | R FXD M FILM 100Ω 1% 1/4W |
| R406 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| R407 | 40-27-1182 | R FXD C FILM 180Ω 5% 1/4W |
| R408 | 48-29-1500 | R VAR M FILM 500Ω |
| R409 | 48-29-3100 | R VAR M FILM 10KΩ |
| R410 | 40-27-2122 | R FXD C FILM 1.2KΩ 5% 1/4W |
| R411 | 42-72-1330 | R FXD M FILM 330Ω 1% 1/4W |
| R412 | 42-72-1330 | R FXD M FILM 330Ω 1% 1/4W |
| R413 | 40-27-2122 | R FXD C FILM 1.2KΩ 5% 1/4W |
| R414 | 40-27-0682 | R FXD C FILM 68Ω 5% 1/4W |
| R415 | 40-27-0682 | R FXD C FILM 68Ω 5% 1/4W |
| R416 | 40-27-1182 | R FXD C FILM 180Ω 5% 1/4W |
| R417* | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| U301 | 35-70-0001 | IC QUAD2-INPUT NAND GATE SN74LS00N |
| U302 | 35-70-0001 | IC QUAD2-INPUT NAND GATE SN74LS00N |
| U303 | 35-70-0741 | IC DUAL D FLIPFLOP SN74LS74N |
| A5 PCB-S A5 | 90-50-2051 | PCB-S A5 VERT DRIVE AMP |
| C422 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C423 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C424 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C426 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C427 | 50-67-0000 | C FXD PLSTC 0.001μF 10% 100V |
| C429 | 57-10-1140 | C VAR CER 5-55PF |
| C430 | 57-10-1110 | C VAR CER 2-22PF |
| C431 | 52-06-3010 | C FXD CER 1PF 500V |
| C432 | 52-06-3010 | C FXD CER 1PF 500V |
| C433 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C434 | 52-06-3165 | C FXD CER 33PF 500V |
| CR421 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR422 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR423 | 32-90-0780 | DIODE ZENER VZ=2.2V 02BZ2.2 TOSHIBA |
| DL501 | 91-90-0001 | DELAY LINE(Z=186Ω) 2m |
| Q421 | 30-30-9451 | TR Si NPN 2SC945-Q NEC |
| Q422 | 30-30-9451 | TR Si NPN 2SC945-Q NEC |
| Q423 | 30-30-9451 | TR Si NPN 2SC945-Q NEC |
| Q424 | 30-30-9451 | TR Si NPN 2SC945-Q NEC |
| Q425 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q426 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q427 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q428 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q429 | 30-32-0550 | TR Si NPN 2SC2055 MITSUBISHI |
| Q430 | 30-32-0550 | TR Si NPN 2SC2055 MITSUBISHI |
| Q431 | 30-32-1201 | TR Si NPN 2SC2120-Y TOSHIBA |
| Q432 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q433 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| R422 | 40-27-1182 | R FXD C FILM 180Ω 5% 1/4W |
| R423 | 40-27-1182 | R FXD C FILM 180Ω 5% 1/4W |
| R424 | 40-27-1182 | R FXD C FILM 180Ω 5% 1/4W |
| R425 | 40-27-1182 | R FXD C FILM 180Ω 5% 1/4W |
| R426 | 40-27-1332 | R FXD C FILM 330Ω 5% 1/4W |
| R427 | 40-27-1332 | R FXD C FILM 330Ω 5% 1/4W |
| R428 | 40-27-2222 | R FXD C FILM 2.2KΩ 5% 1/4W |
| R429 | 40-27-2222 | R FXD C FILM 2.2KΩ 5% 1/4W |
| R430 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R431 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R432 | 40-27-2122 | R FXD C FILM 1.2KΩ 5% 1/4W |
| R433 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R434 | 40-27-1222 | R FXD C FILM 220Ω 5% 1/4W |
| R435 | 40-27-1222 | R FXD C FILM 220Ω 5% 1/4W |
| R436 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R437 | 40-27-1472 | R FXD C FILM 470Ω 5% 1/4W |
| R438 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R439 | 40-27-1392 | R FXD C FILM 390Ω 5% 1/4W |
| R440 | 40-27-1472 | R FXD C FILM 470Ω 5% 1/4W |
| R441 | 40-27-1472 | R FXD C FILM 470Ω 5% 1/4W |
| R442 | 40-27-0222 | R FXD C FILM 22Ω 5% 1/4W |
| R443 | 40-27-1472 | R FXD C FILM 470Ω 5% 1/4W |
| R444 | 40-27-1472 | R FXD C FILM 470Ω 5% 1/4W |
| R445 | 40-27-0222 | R FXD C FILM 22Ω 5% 1/4W |

| REFERENCE DESIGNATOR | KIKUSUI PARTS NO. | DESCRIPTION |
|---|---|---|
| A5 R446 | 48-29-3500 | R VAR M FILM 50KΩ |
| R447 | 48-29-2500 | R VAR M FILM 5KΩ |
| R448 | 48-29-1200 | R VAR M FILM 200Ω |
| R449 | 40-27-0332 | R FXD C FILM 33Ω 5% 1/4W |
| R450 | 40-27-0332 | R FXD C FILM 33Ω 5% 1/4W |
| R451 | 40-27-0332 | R FXD C FILM 33Ω 5% 1/4W |
| R452 | 40-27-1682 | R FXD C FILM 680Ω 5% 1/4W |
| R453 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| R454 | 40-27-2222 | R FXD C FILM 2.2KΩ 5% 1/4W |
| R455 | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| R456 | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| R457 | 40-27-0682 | R FXD C FILM 68Ω 5% 1/4W |
| R458 | 40-27-0682 | R FXD C FILM 68Ω 5% 1/4W |
| R459 | 40-27-0332 | R FXD C FILM 33Ω 5% 1/4W |
| R462 | 40-27-1562 | R FXD C FILM 560Ω 5% 1/4W |
| R463 | 40-27-1562 | R FXD C FILM 560Ω 5% 1/4W |
| R464 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R465 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R466 | 40-27-2222 | R FXD C FILM 2.2KΩ 5% 1/4W |
| R467 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| R468 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| R469 | 48-29-2100 | R VAR M FILM 1KΩ |
| R473 | 40-27-1472 | R FXD C FILM 470Ω 5% 1/4W |
| R474 | 40-27-1472 | R FXD C FILM 470Ω 5% 1/4W |
| R475 | 40-27-1122 | R FXD C FILM 120Ω 5% 1/4W |
| R476 | 40-27-1122 | R FXD C FILM 120Ω 5% 1/4W |
| A6 PCB-S A6 | 90-50-2060 | PCB-S A6 VERT OUTPUT AMP |
| C481 | 52-03-3469 | C FXD CER 0.01μF 500V |
| Q481 | 30-31-0121 | TR Si NPN 2SC1012A MATSUSHITA |
| Q482 | 30-31-0121 | TR Si NPN 2SC1012A MATSUSHITA |
| L481 | 67-00-0010 | PEAKING COIL 3.3 H KIKUSUI S800193 |
| L481 | 67-00-0010 | PEAKING COIL 3.3 H KIKUSUI S800193 |
| R481 | 44-93-1390 | R FXD M OX 390Ω 5% 3W |
| R482 | 44-93-1390 | R FXD M OX 390Ω 5% 3W |
| R483 | 44-93-1390 | R FXD M OX 390Ω 5% 3W |
| R484 | 44-93-1390 | R FXD M OX 390Ω 5% 3W |
| A7 PCB-S A7 | 90-50-2070 | PCB-S A7 TRIG & CRT CONTROL |
| Q1001 | 30-40-3811 | TR Si NPN 2SD381-L NEC |
| R511 (WITH S503) | 45-01-0370 | R VAR C COMP 100KΩ WITH SW RV16YP15SB 100KΩ |
| R512 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R513 | 40-27-1392 | R FXD C FILM 390Ω 5% 1/4W |
| R514 | 46-16-3101 | R VAR M GLAZE 10KΩ RG161P15SB 10KΩ |
| R515 (WITH S505) | 45-01-0390 | R VAR C COMP 10KΩ WITH SW V16L5S(C24ST+ZSC24ST)15SB 10KΩ |
| R1001 | 46-16-2501 | R VAR M GLAZE RG161P15SB 5KΩ |
| R1002 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| R1003 | 46-16-2201 | R VAR M GLAZE RG161P 15SB 2KΩ |
| R1004 | 46-16-3101 | R VAR M GLAZE RG161P 15SB 10KΩ |
| R1005 | 46-16-3101 | R VAR M GLAZE RG161P 15SB 10KΩ |
| R1006 | 46-16-3101 | R VAR M GLAZE RG161P 15SB 10KΩ |
| R1007 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| S503 | - | SEE R511 (A PART OF R511) |
| S504 | 81-01-0300 | SW PUSH KSD1-2-0 1LDC |
| S505 | - | SEE R515 (A PART OF R515) |
| A8 PCB-S A8 | 90-50-2080 | PCB-S A8 SWEEP MODE SW |
| C701 | 52-01-3345 | C FXD CER 1000PF 500WV |
| R701 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| SW701 | 81-04-0150 | SW PUSH KSD5-8-10 MLDC |
| A9 PCB-D A9 | 90-50-2091 | PCB-D A9 TRIG & POWER SUPPLY |
| C521 | 52-01-3385 | C FXD CER 2200PF 500V |
| C523 | 52-06-3185 | C FXD CER 47PF 500V |
| C524 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C525 | 54-00-0301 | C FXD ELECT 1μF 50V |
| C526 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C527 | 54-00-0301 | C FXD ELECT 1μF 50V |
| C528 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C529 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C530 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C531 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C532 | 52-05-1498 | C FXD CER 0.1μF 25V |
| C533 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C534 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C535 | 52-06-3185 | C FXD CER 47PF 500V |
| C536 | 52-06-2225 | C FXD CER 100PF 50V |
| C537 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C538 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C539 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C540 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C541 | 52-06-3185 | C FXD CER 47PF 500V |
| C542 | 52-06-3185 | C FXD CER 47PF 500V |
| C543 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C544 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C545 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C546 | 54-05-2468 | C FXD CER 0.01μF 50V |
| C547 | 52-06-3185 | C FXD CER 47PF 500V |
| C550 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C551 | 54-00-1114 | C FXD ELECT 47μF 25V |
| C552 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C553 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C554 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C555 | 52-05-1498 | C FXD CER 0.1μF 25V |
| C601 | 52-01-3385 | C FXD CER 2200PF 500V |
| C602 | 54-00-0311 | C FXD ELECT 10μF 50V |

| REFERENCE DESIGNATOR | KIKUSUI PARTS NO. | DESCRIPTION |
|---|---|---|
| A9 C603 | 52-06-3205 | C FXD CER 68PF 500V |
| C604 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C605 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C606 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C607 | 54-00-0114 | C FXD ELECT 47μF 25V |
| C608 | 52-06-3145 | C FXD CER 22PF 500V |
| C651 | 52-06-2468 | C FXD CER 0.01μF 50V |
| C652 | 52-06-2225 | C FXD CER 100PF 50V |
| C661 | 54-00-0114 | C FXD ELECT 47μF 25V |
| C702 | 52-06-3051 | C FXD CER 5PF 500V |
| C703 | 52-06-2265 | C FXD CER 220PF 50V |
| C704 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C705 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C706 | 52-06-3102 | C FXD CER 10PF 500V |
| C707 | 54-00-0114 | C FXD ELECT 47μF 25V |
| C708 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C709 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C710 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C711 | 52-05-1498 | C FXD CER 0.1μF 25V |
| C712 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C730 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C731 | 52-06-3145 | C FXD CER 22PF 500V |
| C732 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C733 | 54-00-0114 | C FXD ELECT 47μF 25V |
| C734 | 52-04-2468 | C FXD CER 0.01μF 50V |
| C735 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C1103 | 54-61-1010 | C FXD ELECT 100μF 100V |
| C1104 | 54-61-1080 | C FXD ELECT 10μF 200V |
| C1105 | 54-61-1050 | C FXD ELECT 100μF 160V |
| C1106 | 54-61-1050 | C FXD ELECT 100μF 160V |
| C1107 | 54-61-1010 | C FXD ELECT 100μF 100V |
| C1109 | 52-01-3345 | C FXD CER 1000PF 500V |
| C1110 | 54-00-0314 | C FXD ELECT 47μF 50V |
| C1111 | 54-01-0132 | C FXD ELECT 2200μF 25V |
| C1112 | 54-01-0132 | C FXD ELECT 2200μF 25V |
| C1113 | 54-01-0331 | C FXD ELECT 1000μF 50V |
| C1114 | 52-01-3345 | C FXD CER 1000PF 500V |
| C1115 | 52-01-3345 | C FXD CER 1000PF 500V |
| C1116 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C1117 | 52-01-3345 | C FXD CER 1000PF 500V |
| C1118 | 52-01-3345 | C FXD CER 1000PF 500V |
| C1119 | 50-67-0040 | C FXD PLSTC 0.022μF 100V |
| C1120 | 50-67-0040 | C FXD PLSTC 0.022μF 100V |
| C1121 | 54-01-0132 | C FXD ELECT 2200μF 25V |
| C1122 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C1123 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C1124 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C1125 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C1126 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C1127 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C1128 | 52-05-1498 | C FXD CER 0.1μF 25V |
| C1129 | 52-05-1498 | C FXD CER 0.1μF 25V |
| C1130 | 52-01-3345 | C FXD CER 1000PF 500V |
| C1131 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C1151 | 50-45-0500 | C FXD PLSTC 0.01μF 100V |
| C1152 | 50-45-0500 | C FXD PLSTC 0.01μF 100V |
| C1153 | 54-00-0114 | C FXD ELECT 47μF 25V |
| CR521-CR538 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR601-CR607 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR651-CR653 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR701-CR706 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR708-CR716 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR731-CR735 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR1101 | 32-90-0860 | DIODE BRIDGE Si SIRBA60 SHINDENGEN |
| CR1102 | 32-90-0860 | DIODE BRIDGE Si SIRBA60 |
| CR1103 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR1104 | 32-90-0790 | DIODE BRIDGE Si SIRBA20 SHINDENGEN |
| CR1105 | 32-90-0790 | DIODE BRIDGE Si SIRBA20 |
| CR1106 | 32-11-5880 | DIODE Si 1S1588 |
| CR1107 | 32-90-0520 | DIODE Si V06G HITACHI |
| Q501 | 30-10-7810 | TR Si PNP 2SA781 HITACHI |
| Q502 | 31-20-0580 | TR FET 2SK58 SONY |
| Q503 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q504 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q505 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q506 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q507 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q508 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q509 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q510 | 30-10-7810 | TR Si PNP 2SA781 HITACHI |
| Q511 | 30-10-7810 | TR Si PNP 2SA781 HITACHI |
| Q512 | 30-10-7810 | TR Si PNP 2SA781 HITACHI |
| Q513 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q514 | 30-30-9451 | TR Si NPN 2SC945-Q NEC |
| Q515 | 30-30-9451 | TR Si NPN 2SC945-Q NEC |
| Q516 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q517 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q518 | 30-30-9451 | TR Si NPN 2SC945-Q NEC |
| Q601 | 31-20-1073 | TR FET 2SK107-3 SONY |
| Q602 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q603 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q604 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q605 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q606 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q607 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q608 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |

| REFERENCE DESIGNATOR | KIKUSUI PARTS NO. | DESCRIPTION |
|---|---|---|
| A9 Q609 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q610 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q611 | 30-10-7810 | TR Si PNP 2SA781 HITACHI |
| Q612 | 30-10-7810 | TR Si PNP 2SA781 HITACHI |
| Q613 | 30-10-7810 | TR Si PNP 2SA781 HITACHI |
| Q614 | 30-30-9451 | TR Si NPN 2SC945-Q NEC |
| Q651 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q652 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q701 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q702 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q703 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q704 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q705 | 30-30-9451 | TR Si NPN 2SC945-Q NEC |
| Q706 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q707 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q708 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q709 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q710 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q711 | 30-10-8441 | TR Si PNP 2SA844-E HITACHI |
| Q712 | 30-10-8441 | TR Si PNP 2SA844-E HITACHI |
| Q1102 | 30-30-9451 | TR Si NPN 2SC945-O NEC |
| Q1103 | 30-32-3710 | TR Si NPN 2SC2371-L NEC |
| Q1104 | 30-32-3710 | TR Si NPN 2SC2371-L NEC |
| Q1107 | 30-30-9451 | TR Si NPN 2SC945-Q NEC |
| Q1109 | 30-30-9451 | TR Si NPN 2SC945-Q NEC |
| Q1110 | 30-30-9451 | TR Si NPN 2SC945-Q NEC |
| R521 | 40-27-0682 | R FXD C FILM 68Ω 5% 1/4W |
| R522 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R523 | 42-72-1560 | R FXD M FILM 560Ω 1% 1/4W |
| R524 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R525 | 42-72-2270 | R FXD M FILM 2.7KΩ 1% 1/4W |
| R526 | 40-27-1562 | R FXD C FILM 560Ω 5% 1/4W |
| R527 | 40-37-5101 | R FXD C FILM 1MΩ 5% 1/2W |
| R528 | 40-27-4472 | R FXD C FILM 470KΩ 5% 1/4W |
| R529 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R530 | 40-27-0682 | R FXD C FILM 68Ω 5% 1/4W |
| R531 | 40-27-0682 | R FXD C FILM 68Ω 5% 1/4W |
| R532* | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| R533 | 48-29-2200 | R VAR M FILM 2KΩ |
| R534 | 40-27-2332 | R FXD C FILM 3.3KΩ 5% 1/4W |
| R535 | 40-27-1222 | R FXD C FILM 220Ω 5% 1/4W |
| R536 | 40-27-2332 | R FXD C FILM 3.3KΩ 5% 1/4W |
| R537 | 40-27-3152 | R FXD C FILM 15KΩ 5% 1/4W |
| R538 | 40-27-1562 | R FXD C FILM 560Ω 5% 1/4W |
| R539 | 48-29-2100 | R VAR M FILM 1KΩ |
| R540 | 40-27-4102 | R FXD C FILM 100KΩ 5% 1/4W |
| R541 | 40-27-4102 | R FXD C FILM 100KΩ 5% 1/4W |
| R542 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R543 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R544 | 40-27-2222 | R FXD C FILM 2.2KΩ 5% 1/4W |
| R545 | 40-27-2332 | R FXD C FILM 3.3KΩ 5% 1/4W |
| R546 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R547 | 40-27-1332 | R FXD C FILM 330Ω 5% 1/4W |
| R548 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R549 | 40-27-2222 | R FXD C FILM 2.2KΩ 5% 1/4W |
| R550 | 40-27-2332 | R FXD C FILM 3.3KΩ 5% 1/4W |
| R551 | 40-27-1222 | R FXD C FILM 220Ω 5% 1/4W |
| R552 | 40-27-1222 | R FXD C FILM 220Ω 5% 1/4W |
| R553 | 40-27-2472 | R FXD C FILM 4.7KΩ 5% 1/4W |
| R554 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R555 | 48-29-1500 | R VAR M FILM 500Ω |
| R556 | 40-27-1472 | R FXD C FILM 470Ω 5% 1/4W |
| R557 | 40-27-2272 | R FXD C FILM 2.7KΩ 5% 1/4W |
| R558 | 40-27-2152 | R FXD C FILM 1.5KΩ 5% 1/4W |
| R559 | 40-27-1472 | R FXD C FILM 470Ω 5% 1/4W |
| R560 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R561 | 40-27-1562 | R FXD C FILM 560Ω 5% 1/4W |
| R562 | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| R563 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R564 | 40-27-1562 | R FXD C FILM 560Ω 5% 1/4W |
| R565 | 40-27-4472 | R FXD C FILM 470KΩ 5% 1/4W |
| R566 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| R567 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R568 | 40-27-1562 | R FXD C FILM 560Ω 5% 1/4W |
| R569 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| R570 | 40-27-1332 | R FXD C FILM 330Ω 5% 1/4W |
| R571 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R572 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R573 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R574 | 40-27-3222 | R FXD C FILM 22KΩ 5% 1/4W |
| R575 | 40-27-3222 | R FXD C FILM 22KΩ 5% 1/4W |
| R576 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R577 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R578 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R579 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R580 | 40-27-2272 | R FXD C FILM 2.7KΩ 5% 1/4W |
| R581 | 40-27-2272 | R FXD C FILM 2.7KΩ 5% 1/4W |
| R582 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| R583 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| R584 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| R585 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| R586 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R587 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R588 | 40-27-1562 | R FXD C FILM 560Ω 5% 1/4W |
| R591 | 40-27-0102 | R FXD C FILM 10Ω 5% 1/4W |
| R592 | 40-27-0102 | R FXD C FILM 10Ω 5% 1/4W |
| R593 | 40-27-0102 | R FXD C FILM 10Ω 5% 1/4W |
| R594 | 40-27-0102 | R FXD C FILM 10Ω 5% 1/4W |
| R601 | 47-37-5101 | R FXD C FILM 1MΩ 5% 1/2W |
| R602 | 40-27-4472 | R FXD C FILM 470KΩ 5% 1/4W |
| R603 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |

| RIFERENCE DISIGNATOR | KIKUSUI PARTS NO. | DESCRIPTION |
|---|---|---|
| A | R604 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| | R605 | 40-27-1562 | R FXD C FILM 560Ω 5% 1/4W |
| | R606 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| | R607 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| | R608 | 40-27-2472 | R FXD C FILM 4.7KΩ 5% 1/4W |
| | R609 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| | R610 | 40-27-4102 | R FXD C FILM 100KΩ 5% 1/4W |
| | R611 | 40-27-4102 | R FXD C FILM 100KΩ 5% 1/4W |
| | R613 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| | R614 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| | R615 | 40-27-3152 | R FXD C FILM 15KΩ 5% 1/4W |
| | R616 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| | R617 | 40-27-3122 | R FXD C FILM 12KΩ 5% 1/4W |
| | R618 | 48-29-1100 | R VAR M FILM 100Ω |
| | R619 | 40-27-2182 | R FXD C FILM 1.8KΩ 5% 1/4W |
| | R620 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| | R621 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| | R622 | 40-27-3182 | R FXD C FILM 18KΩ 5% 1/4W |
| | R623 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| | R624 | 40-27-2222 | R FXD C FILM 2.2KΩ 5% 1/4W |
| | R625 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| | R626 | 40-27-2222 | R FXD C FILM 2.2KΩ 5% 1/4W |
| | R627 | 40-27-2222 | R FXD C FILM 2.2KΩ 5% 1/4W |
| | R628 | 40-27-1222 | R FXD C FILM 220Ω 5% 1/4W |
| | R629 | 40-27-1272 | R FXD C FILM 270Ω 5% 1/4W |
| | R630 | 40-27-2472 | R FXD C FILM 4.7KΩ 5% 1/4W |
| | R632 | 40-27-2272 | R FXD C FILM 2.7KΩ 5% 1/4W |
| | R633 | 40-27-1472 | R FXD C FILM 470Ω 5% 1/4W |
| | R634 | 48-29-2100 | R VAR M FILM 1KΩ |
| | R635 | 40-27-1332 | R FXD C FILM 330Ω 5% 1/4W |
| | R636 | 40-27-1562 | R FXD C FILM 560Ω 5% 1/4W |
| | R637 | 40-27-0822 | R FXD C FILM 82Ω 5% 1/4W |
| | R638 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| | R639 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| | R640 | 40-27-0102 | R FXD C FILM 10Ω 5% 1/4W |
| | R641 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| | R642 | 40-27-3222 | R FXD C FILM 22KΩ 5% 1/4W |
| | R643 | 40-27-2272 | R FXD C FILM 2.7KΩ 5% 1/4W |
| | R651 | 40-27-3122 | R FXD C FILM 12KΩ 5% 1/4W |
| | R653 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| | R654 | 40-27-0102 | R FXD C FILM 10Ω 5% 1/4W |
| | R655 | 40-27-2222 | R FXD C FILM 2.2KΩ 5% 1/4W |
| | R656 | 40-27-3152 | R FXD C FILM 15KΩ 5% 1/4W |
| | R657 | 40-27-3122 | R FXD C FILM 12KΩ 5% 1/4W |
| | R658 | 40-27-2222 | R FXD C FILM 2.2KΩ 5% 1/4W |
| | R659 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| | R660 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| | R661 | 40-27-0102 | R FXD C FILM 10Ω 5% 1/4W |
| | R662 | 40-27-0682 | R FXD C FILM 68Ω 5% 1/4W |
| | R663 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| | R664 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| | R665 | 40-27-2822 | R FXD C FILM 8.2KΩ 5% 1/4W |
| | R666 | 40-27-2222 | R FXD C FILM 2.2KΩ 5% 1/4W |
| | R702 | 40-27-1682 | R FXD C FILM 680Ω 5% 1/4W |
| | R703 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| | R704 | 40-27-1472 | R FXD C FILM 470Ω 5% 1/4W |
| | R705 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| | R706 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| | R707 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| | R708 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| | R709 | 40-27-2222 | R FXD C FILM 2.2KΩ 5% 1/4W |
| | R710 | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| | R711 | 40-27-3222 | R FXD C FILM 22KΩ 5% 1/4W |
| | R712 | 40-27-2392 | R FXD C FILM 3.9KΩ 5% 1/4W |
| | R713 | 40-27-3222 | R FXD C FILM 22KΩ 5% 1/4W |
| | R714 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| | R715 | 40-27-1222 | R FXD C FILM 220Ω 5% 1/4W |
| | R716 | 40-27-2222 | R FXD C FILM 2.2KΩ 5% 1/4W |
| | R717 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| | R718 | 40-27-2392 | R FXD C FILM 3.9KΩ 5% 1/4W |
| | R719 | 40-37-3471 | R FXD C FILM 47KΩ 5% 1/2W |
| | R720 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| | R721 | 40-27-3472 | R FXD C FILM 47KΩ 5% 1/4W |
| | R722 | 40-27-1562 | R FXD C FILM 560Ω 5% 1/4W |
| | R723 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| | R724 | 40-27-3152 | R FXD C FILM 15KΩ 5% 1/4W |
| | R725 | 48-29-2500 | R VAR M FILM 5KΩ |
| | R726 | 40-27-3222 | R FXD C FILM 22KΩ 5% 1/4W |
| | R727 | 40-27-0102 | R FXD C FILM 10Ω 5% 1/4W |
| | R728 | 40-27-0102 | R FXD C FILM 10Ω 5% 1/4W |
| | R729 | 40-27-0102 | R FXD C FILM 10Ω 5% 1/4W |
| | R730 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| | R731 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| | R732 | 40-27-1562 | R FXD C FILM 560Ω 5% 1/4W |
| | R733 | 40-27-3152 | R FXD C FILM 15KΩ 5% 1/4W |
| | R734 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| | R735 | 48-29-2500 | R VAR M FILM 5KΩ |
| | R736 | 40-27-3222 | R FXD C FILM 22KΩ 5% 1/4W |
| | R737 | 40-27-2222 | R FXD C FILM 2.2KΩ 5% 1/4W |
| | R738 | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| | R739 | 40-27-3222 | R FXD C FILM 22KΩ 5% 1/4W |
| | R740 | 40-27-2392 | R FXD C FILM 3.9KΩ 5% 1/4W |
| | R741 | 40-27-1822 | R FXD C FILM 820Ω 5% 1/4W |
| | R742 | 40-27-0102 | R FXD C FILM 10Ω 5% 1/4W |
| | R743 | 40-27-0102 | R FXD C FILM 10Ω 5% 1/4W |
| | R744 | 40-27-4222 | R FXD C FILM 220KΩ 5% 1/4W |
| | R745 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| | R746 | 40-27-0332 | R FXD C FILM 33Ω 5% 1/4W |
| | R747 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| | R748 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| | R749 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| | R750 | 40-27-4472 | R FXD C FILM 470KΩ 5% 1/4W |
| | R751 | 40-27-4472 | R FXD C FILM 470KΩ 5% 1/4W |
| | R790 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |

| REFERENCE DESIGNATOR | KIKUSUI PARTS NO. | DESCRIPTION |
|---|---|---|
| A9 | R1101 | 41-91-3680 | R FXD M OX 68KΩ 5% 1W |
| | R1102 | 44-92-2100 | R FXD M OX 1KΩ 5% 2W |
| | R1103 | 40-27-3472 | R FXD C FILM 47KΩ 5% 1/4W |
| | R1104 | 40-27-3472 | R FXD C FILM 47KΩ 5% 1/4W |
| | R1105 | 40-37-8222 | R FXD C FILM 2.2Ω 5% 1/2W |
| | R1107 | 40-27-1222 | R FXD C FILM 220Ω 5% 1/4W |
| | R1108 | 42-72-3680 | R FXD M FILM 68KΩ 1% 1/4W |
| | R1109 | 42-72-3100 | R FXD M FILM 10KΩ 1% 1/4W |
| | R1110 | 40-27-1222 | R FXD C FILM 220Ω 5% 1/4W |
| | R1111 | 40-27-1152 | R FXD C FILM 150Ω 5% 1/4W |
| | R1112 | 44-92-1150 | R FXD M OX 150Ω 5% 2W |
| | R1113 | 40-37-8222 | R FXD C FILM 2.2Ω 5% 1/2W |
| | R1114 | 40-37-8222 | R FXD C FILM 2.2Ω 5% 1/2W |
| | R1116 | 44-92-1150 | R FXD M OX 150Ω 5% 2W |
| | R1117 | 40-27-1152 | R FXD C FILM 150Ω 5% 1/4W |
| | R1118 | 40-37-8222 | R FXD C FILM 2.2Ω 5% 1/2W |
| | R1119 | 40-37-8222 | R FXD C FILM 2.2Ω 5% 1/2W |
| | R1121 | 47-72-2100 | R FXD M FILM 1KΩ 1% 1/4W |
| | R1122 | 40-27-2152 | R FXD C FILM 1.5KΩ 5% 1/4W |
| | R1123 | 48-29-2100 | R VAR M FILM 1KΩ |
| | R1124 | 42-72-3120 | R FXD M FILM 12KΩ 1% 1/4W |
| | R1125 | 42-72-3120 | R FXD M FILM 12KΩ 1% 1/4W |
| | R1131 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| | R1132 | 40-27-2122 | R FXD C FILM 1.2KΩ 5% 1/4W |
| | R1133 | 40-37-8222 | R FXD C FILM 2.2Ω 5% 1/2W |
| | R1134 | 40-37-8222 | R FXD C FILM 2.2Ω 5% 1/2W |
| | R1136 | 40-27-1222 | R FXD C FILM 220Ω 5% 1/4W |
| | R1137 | 42-72-2200 | R FXD M FILM 2KΩ 1% 1/4W |
| | R1138 | 42-72-2560 | R FXD M FILM 5.6KΩ 1% 1/4W |
| | R1141 | 40-37-5101 | R FXD C FILM 1MΩ 5% 1/2W |
| | R1142 | 40-37-5101 | R FXD C FILM 1MΩ 5% 1/2W |
| | R1151* | 40-27-3822 | R FXD C FILM 82KΩ 5% 1/4W |
| | R1152 | 48-29-3500 | R VAR M FILM 50KΩ |
| | R1153 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| | R1154 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| | R1155 | 40-27-4102 | R FXD C FILM 100KΩ 5% 1/4W |
| | R1156 | 40-27-4102 | R FXD C FILM 100KΩ 5% 1/4W |
| | R1157 | 40-27-3222 | R FXD C FILM 22KΩ 5% 1/4W |
| | R1158 | 40-27-4472 | R FXD C FILM 470KΩ 5% 1/4W |
| | R1159 | 42-72-2680 | R FXD M FILM 6.8KΩ 1% 1/4W |
| | R1160 | 48-29-2500 | R VAR M FILM 5KΩ |
| | R1161 | 42-72-2180 | R FXD M FILM 1.8KΩ 1% 1/4W |
| | R1162 | 42-71-1200 | R FXD M FILM 200Ω 0.5% 1/4W |
| | R1163 | 40-27-0102 | R FXD C FILM 10Ω 5% 1/4W |
| | S1101 | 81-01-0270 | SW PUSH POWER SDG-5P |
| | U501 | 35-70-0002 | IC SN74S00N |
| | U502 | 35-70-0001 | IC SN74LS00N |
| | U503 | 35-70-1231 | IC SN74LS123N |
| | U504 | 35-70-0001 | IC SN74LS00N |
| | U601 | 35-70-0002 | IC SN74S00N |
| | U701 | 35-70-1122 | IC SN74S112N |
| | U702 | 35-70-0001 | IC SN74LS00N |
| | U703 | 35-70-0001 | IC SN74LS00N |
| | U704 | 35-70-1122 | IC SN74S112N |
| | U705 | 35-70-0001 | IC SN74LS00N |
| | U1101 | 34-40-0070 | IC TA7179P DUAL TRACKING REGULATOR |
| | U1102 | 35-60-0000 | IC TA4011P C-MOS |
| A10 | PCB-D A10 | 90-50-2100 | PCB-D A10 SWEEP & HORIZ DRIVE |
| | C750 | 52-03-3469 | C FXD CER 0.01μF 500V |
| | C751 | 52-05-1498 | C FXD CER 0.1μF 25V |
| | C801 | 52-05-2468 | C FXD CER 0.01μF 50V |
| | C802 | 57-10-1110 | C VAR CER 2-22PF |
| | C803 | 52-06-3215 | C FXD CER 82PF 500V |
| | C804 | 50-63-3500 | C FXD PLASTIC 1μF 1% 200V |
| | C805 | 50-73-3500 | C FXD PLASTIC 0.01μF 1% 200V |
| | C806 | 54-00-0311 | C FXD ELECT 10μF 50V |
| | C807 | 54-00-0311 | C FXD ELECT 10μF 50V |
| | C808 | 54-00-0311 | C FXD ELECT 10μF 50V |
| | C809 | 52-05-2468 | C FXD CER 0.01μF 50V |
| | C810 | 52-05-2468 | C FXD CER 0.01μF 50V |
| | C811 | 52-05-1498 | C FXD CER 0.1μF 25V |
| | C851 | 52-05-2468 | C FXD CER 0.01μF 50V |
| | C852 | 57-10-1110 | C VAR CER 2-22PF |
| | C853 | 52-06-3215 | C FXD CER 82PF 500V |
| | C854 | 50-63-3500 | C FXD PLASTIC 1μF 1% 200V |
| | C855 | 50-73-3500 | C FXD PLASTIC 0.01μF 1% 200V |
| | C856 | 52-03-3469 | C FXD CER 0.01μF 500V |
| | C857 | 52-05-2468 | C FXD CER 0.01μF 50V |
| | C858 | 54-00-0311 | C FXD ELECT 10μF 50V |
| | C859 | 52-05-2468 | C FXD CER 0.01μF 50V |
| | C861 | 52-05-1498 | C FXD CER 0.1μF 25V |
| | C862 | 52-05-2468 | C FXD CER 0.01μF 50V |
| | C901 | 54-00-0311 | C FXD ELECT 10μF 50V |
| | C902 | 52-05-2468 | C FXD CER 0.01μF 50V |
| | C903 | 52-05-2468 | C FXD CER 0.01μF 50V |
| | C921 | 52-06-2245 | C FXD CER 150PF 50V |
| | C922 | 52-06-2245 | C FXD CER 150PF 50V |
| | C931 | 52-05-2468 | C FXD CER 0.01μF 50V |
| | C932* | 52-06-3205 | C FXD CER 68PF 500V |
| | C935 | 52-01-3305 | C FXD CER 470PF 500V |
| | C936 | 52-05-2468 | C FXD CER 0.01μF 50V |
| | C937 | 52-05-2468 | C FXD CER 0.01μF 50V |
| | C938 | 54-00-0311 | C FXD ELECT 10μF 50V |

| REFERENCE DESIGNATOR | KIKUSUI PARTS NO | DESCRIPTION |
|---|---|---|
| A10 C939 | 54-00-0114 | C FXD ELECT 47μF 25V |
| C940 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C941 | 52-05-2468 | C FXD CER 0.01μF 50V |
| C942 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C951 | 54-00-0311 | C FXD ELECT 10μF 50V |
| CR751 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR752 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR753 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR801 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR811 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR812 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR813 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR814 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR815 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR851 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR861 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR902 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR903 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR904 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR905 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR906 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR907 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR908 | 32-91-1800 | DIODE Si RD5.6J-B VZ5.3-6.0V NEC |
| CR909 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR932 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR933 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| CR934 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| Q751 | 31-90-0041 | FET DUAL μPA63H-1 ΔVGS≤30mV NEC |
| Q752 | 30-30-9451 | TR Si NPN 2SC945-Q NEC |
| Q753 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q754 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q755 | 30-30-9451 | TR Si NPN 2SC945-Q NEC |
| Q801 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q802 | 31-20-1171 | FET 2SK117-BL1 TOSHIBA |
| Q803 | 31-20-1171 | FET 2SK117-BL1 TOSHIBA |
| Q804 | 31-90-0041 | FET DUAL μPA63H-1 ΔVGS≤30mV NEC |
| Q805 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q806 | 31-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q807 | 30-30-9451 | TR Si NPN 2SC945-Q NEC |
| Q808 | 30-30-9451 | TR Si NPN 2SC945-Q NEC |
| Q809 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q810 | 30-30-9451 | TR Si NPN 2SC945-Q NEC |
| Q811 | 30-30-9451 | TR Si NPN 2SC945-Q NEC |
| Q851 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q852 | 31-20-1171 | FET 2SK117-BL TOSHIBA |
| Q853 | 31-20-1171 | FET 2SK117-BL TOSHIBA |
| Q854 | 31-90-0041 | FET DUAL μPA63H-1 ΔVGS≤30mV NEC |
| Q855 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q856 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q857 | 30-30-9451 | TR Si NPN 2SC945-Q NEC |
| Q858 | 30-30-9451 | TR Si NPN 2SC945-Q NEC |
| Q859 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q860 | 30-30-9451 | TR Si NPN 2SC945-Q NEC |
| Q861 | 30-30-9451 | TR Si NPN 2SC945-Q NEC |
| Q901 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q902 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q903 | 30-30-9451 | TR Si NPN 2SC945-Q NEC |
| Q904 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q905 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q906 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q907 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q908 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q909 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q910 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q911 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q912 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| Q913 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| QCR801-809 | 30-30-9451 | TR Si NPN DIODE CONNE 2SC945-Q NEC |
| QCR851-859 | 30-30-9451 | TR Si NPN DIODE CONNE 2SC945-Q NEC |
| R752 | 40-37-3101 | R FXD C FILM 10KΩ 5% 1/2W |
| R753 | 40-37-3221 | R FXD C FILM 22KΩ 5% 1/2W |
| R754 | 40-37-3221 | R FXD C FILM 22KΩ 5% 1/2W |
| R755 | 40-27-3562 | R FXD C FILM 56KΩ 5% 1/4W |
| R756 | 40-27-1682 | R FXD C FILM 680Ω 5% 1/4W |
| R757 | 40-27-2222 | R FXD C FILM 2.2KΩ 5% 1/4W |
| R758 | 40-27-2222 | R FXD C FILM 2.2KΩ 5% 1/4W |
| R759 | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| R760 | 40-27-2332 | R FXD C FILM 3.3KΩ 5% 1/4W |
| R761 | 40-27-1472 | R FXD C FILM 470Ω 5% 1/4W |
| R763 | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| R764 | 48-12-1201 | R VAR M FILM 200Ω |
| R765 | 40-27-1332 | R FXD C FILM 330Ω 5% 1/4W |
| R766 | 42-72-2220 | R FXD M FILM 2.2KΩ 1% 1/4W |

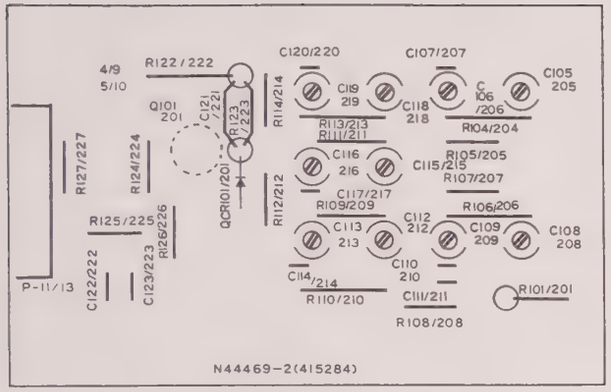
| REFERENCE DESIGNATOR | KIKUSUI PARTS NO | DESCRIPTION |
|---|---|---|
| A10 R767 | 42-72-3120 | R FXD M FILM 12KΩ 1% 1/4W |
| R768 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| R769 | 48-12-2201 | R VAR M FILM 2KΩ |
| R770 | 40-27-2392 | R FXD C FILM 3.9KΩ 5% 1/4W |
| R771 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R772 | 40-27-2222 | R FXD C FILM 2.2KΩ 5% 1/4W |
| R801 | 40-27-2472 | R FXD C FILM 4.7KΩ 5% 1/4W |
| R802 | 40-27-1222 | R FXD C FILM 220Ω 5% 1/4W |
| R803 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| R804 | 40-27-2471 | R FXD C FILM 4.7KΩ 5% 1/2W |
| R805 | 40-27-0682 | R FXD C FILM 680Ω 5% 1/4W |
| R806 | 40-27-1472 | R FXD C FILM 470Ω 5% 1/4W |
| R807 | 40-27-1472 | R FXD C FILM 470Ω 5% 1/4W |
| R808 | 42-24-0231 | R FXD M GLAZE 5MΩ 1% 0.315W |
| R809 | 42-24-0221 | R FXD M GLAZE 2MΩ 1% 0.315W |
| R810 | 42-73-5100 | R FXD M FILM 1MΩ 0.5% 1/2W |
| R811 | 42-73-4500 | R FXD M FILM 500KΩ 0.5% 1/2W |
| R812 | 42-71-4200 | R FXD M FILM 200KΩ 0.5% 1/4W |
| R813 | 42-71-4100 | R FXD M FILM 100KΩ 0.5% 1/4W |
| R814 | 42-71-3500 | R FXD M FILM 50KΩ 0.5% 1/4W |
| R815 | 42-71-3200 | R FXD M FILM 20KΩ 0.5% 1/4W |
| R816 | 42-71-3100 | R FXD M FILM 10KΩ 0.5% 1/4W |
| R817 | 40-27-2392 | R FXD C FILM 3.9KΩ 5% 1/4W |
| R818 | 40-27-1272 | R FXD C FILM 270Ω 5% 1/4W |
| R819 | 40-27-1272 | R FXD C FILM 270Ω 5% 1/4W |
| R820 | 40-27-2122 | R FXD C FILM 1.2KΩ 5% 1/4W |
| R821 | 42-72-2220 | R FXD M FILM 2.2KΩ 1% 1/4W |
| R822 | 48-29-1500 | R VAR M FILM 500Ω |
| R823 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| R824 | 40-27-2222 | R FXD C FILM 2.2KΩ 5% 1/4W |
| R825 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| R826 | 40-27-0332 | R FXD C FILM 33Ω 5% 1/4W |
| R827 | 40-27-2222 | R FXD C FILM 2.2KΩ 5% 1/4W |
| R828 | 40-27-2222 | R FXD C FILM 2.2KΩ 5% 1/4W |
| R829 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R830 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R831 | 44-08-0010 | R FXD RESISTOR NETWORKS 10KΩ |
| R832 | 40-27-4472 | R FXD C FILM 470KΩ 5% 1/4W |
| R833 | 40-27-4472 | R FXD C FILM 470KΩ 5% 1/4W |
| R834 | 40-27-3392 | R FXD C FILM 39KΩ 5% 1/4W |
| R851 | 40-27-2472 | R FXD C FILM 4.7KΩ 5% 1/4W |
| R852 | 40-27-1222 | R FXD C FILM 220Ω 5% 1/4W |
| R853 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| R854 | 40-37-2471 | R FXD C FILM 4.7KΩ 5% 1/2W |
| R855 | 40-27-0682 | R FXD C FILM 680Ω 5% 1/4W |
| R856 | 40-27-1472 | R FXD C FILM 470Ω 5% 1/4W |
| R857 | 40-27-1472 | R FXD C FILM 470Ω 5% 1/4W |
| R858 | 42-24-0231 | R FXD M GLAZE 5MΩ 1% 0.315W |
| R859 | 42-24-0221 | R FXD M GLAZE 2MΩ 1% 0.315W |
| R860 | 42-73-5100 | R FXD M FILM 1MΩ 0.5% 1/2W |
| R861 | 42-73-4500 | R FXD M FILM 500KΩ 0.5% 1/2W |
| R862 | 42-71-4200 | R FXD M FILM 200KΩ 0.5% 1/4W |
| R863 | 42-71-4100 | R FXD M FILM 100KΩ 0.5% 1/4W |
| R864 | 42-71-3500 | R FXD M FILM 50KΩ 0.5% 1/4W |
| R865 | 42-71-3200 | R FXD M FILM 20KΩ 0.5% 1/4W |
| R866 | 42-71-3100 | R FXD M FILM 10KΩ 0.5% 1/4W |
| R867 | 40-27-2392 | R FXD C FILM 3.9KΩ 5% 1/4W |
| R868 | 40-27-1272 | R FXD C FILM 270Ω 5% 1/4W |
| R869 | 40-27-1272 | R FXD C FILM 270Ω 5% 1/4W |
| R871 | 48-29-2500 | R VAR M FILM 5KΩ |
| R872 | 40-27-4472 | R FXD C FILM 470KΩ 5% 1/4W |
| R873 | 40-27-4472 | R FXD C FILM 470KΩ 5% 1/4W |
| R874 | 40-27-2222 | R FXD C FILM 2.2KΩ 5% 1/4W |
| R875 | 40-27-2222 | R FXD C FILM 2.2KΩ 5% 1/4W |
| R876 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R877 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R878 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| R879 | 40-27-0332 | R FXD C FILM 33Ω 5% 1/4W |
| R880 | 40-27-2272 | R FXD C FILM 2.7KΩ 5% 1/4W |
| R881 | 40-27-2272 | R FXD C FILM 2.7KΩ 5% 1/4W |
| R882 | 44-08-0010 | R FXD RESISTOR NETWORKS 10KΩ |
| R884 | 40-27-3392 | R FXD C FILM 39KΩ 5% 1/4W |
| R901 | 42-72-2270 | R FXD M FILM 2.7KΩ 1% 1/4W |
| R902 | 48-29-2100 | R VAR M FILM 1KΩ |
| R903 | 42-72-2100 | R FXD M FILM 1KΩ 1% 1/4W |
| R904 | 40-27-1102 | R FXD M FILM 100Ω 5% 1/4W |
| R905 | 42-72-2270 | R FXD M FILM 2.7KΩ 1% 1/4W |
| R906 | 48-29-2100 | R VAR M FILM 1KΩ |
| R907 | 42-72-2100 | R FXD M FILM 1KΩ 1% 1/4W |
| R908 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R909 | 48-29-1200 | R VAR M FILM 200Ω |
| R910 | 42-72-1470 | R FXD M FILM 470Ω 1% 1/4W |
| R911 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| R912 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| R913 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| R914 | 40-27-2332 | R FXD C FILM 3.3KΩ 5% 1/4W |
| R915 | 40-27-3272 | R FXD C FILM 27KΩ 5% 1/4W |
| R916 | 40-27-2332 | R FXD C FILM 3.3KΩ 5% 1/4W |
| R921 | 44-08-0010 | R FXD RESISTOR NETWORKS 10KΩ |
| R923 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| R924 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| R931 | 40-27-2222 | R FXD C FILM 2.2KΩ 5% 1/4W |
| R932 | 40-27-2222 | R FXD C FILM 2.2KΩ 5% 1/4W |
| R933 | 42-72-1120 | R FXD M FILM 120Ω 1% 1/4W |
| R934 | 42-72-2220 | R FXD M FILM 2.2KΩ 1% 1/4W |
| R935 | 42-72-2220 | R FXD M FILM 2.2KΩ 1% 1/4W |
| R936 | 42-72-2120 | R FXD M FILM 1.2KΩ 1% 1/4W |
| R937 | 48-29-2500 | R VAR M FILM 5KΩ |
| R939 | 48-29-3500 | R VAR M FILM 50KΩ |
| R940 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |

| REFERENCE DESIGNATOR | | KIKUSUI PARTS NO. | DESCRIPTION |
|---|---|---|---|
| A10 | R941 | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| | R942 | 40-27-1152 | R FXD C FILM 150Ω 5% 1/4W |
| | R943 | 40-27-1152 | R FXD C FILM 150Ω 5% 1/4W |
| | R944 | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| | R945 | 40-27-2152 | R FXD C FILM 1.5KΩ 5% 1/4W |
| | R946 | 40-27-2332 | R FXD C FILM 3.3KΩ 5% 1/4W |
| | R947 | 40-27-2472 | R FXD C FILM 4.7KΩ 5% 1/4W |
| | R948 | 40-27-1392 | R FXD C FILM 390Ω 5% 1/4W |
| | R949 | 40-27-1392 | R FXD C FILM 390Ω 5% 1/4W |
| | R951 | 40-27-0102 | R FXD C FILM 10Ω 5% 1/4W |
| | R952 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| | R953 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| | R954 | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| | R955 | 40-27-4102 | R FXD C FILM 100KΩ 5% 1/4W |
| | R956 | 40-27-3102 | R FXD C FILM 10KΩ 5% 1/4W |
| | R957 | 40-27-3222 | R FXD C FILM 22KΩ 5% 1/4W |
| | R958 | 40-27-2682 | R FXD C FILM 6.8KΩ 5% 1/4W |
| | R959 | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| | U801 | 35-70-0001 | IC QUAD2-1/P NAND SN74LS00N |
| | U802 | 35-70-0081 | IC QUAD2-1/P AND SN74LS08N |
| | U803 | 35-70-0001 | IC QUAD2-1/P NAND SN74LS00N |
| | U804 | 35-70-0001 | IC QUAD2-1/P NAND SN74LS00N |
| | U805 | 30-90-0120 | IC TRANSISTOR ARRAY μPA56C |
| | U806 | 35-70-0001 | IC QUAD2-1/P NAND SN74LS00N |
| | U851 | 35-70-0001 | IC QUAD2-1/P NAND SN74LS00N |
| | U852 | 35-70-0081 | IC QUAD2-1/P AND SN74LS08N |
| | U853 | 35-70-0001 | IC QUAD2-1/P NAND SN74LS00N |
| | U854 | 35-70-0001 | IC QUAD2-1/P NAND SN74LS00N |
| | U855 | 30-90-0120 | IC TRANSISTOR ARRAY μPA56C |
| | U856 | 35-70-0001 | IC QUAD2-1/P NAND SN74LS00N |
| | U901 | 35-70-0741 | IC DUAL D,F,F SN74LS74N |
| | U902 | 35-70-0001 | IC QUAD2-1/P NAND SN74LS00N |
| A11 | PCB-S A11 | 90-50-2110 | PCB-S A11 DISPLAY MODE SW |
| | SW901 | 81-05-0120 | SW PUSH KSD-5-10-10 MIDC |
| A12 | PCB-S A12 | 90-50-2120 | PCB-S A12 HORIZ OUTPUT AMP |
| | C962 | 52-05-2468 | C FXD CER 0.01μF 50V |
| | C963 | 52-05-2468 | C FXD CER 0.01μF 50V |
| | C964 | 50-05-2468 | C FXD CER 0.01μF 50V |
| | C965 | 52-05-1498 | C FXD CER 0.1μF 25V |
| | C966 | 52-03-3469 | C FXD CER 0.01μF 500V |
| | C967 | 52-05-2468 | C FXD CER 0.01μF 50V |
| | C968 | 52-05-2468 | C FXD CER 0.01μF 50V |
| | C969 | 52-05-2468 | C FXD CER 0.01μF 50V |
| | C970 | 52-05-2468 | C FXD CER 0.01μF 50V |
| | CR961 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| | CR962 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| | CR963 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| | CR964 | 32-11-5880 | DIODE Si 1S1588 TOSHIBA |
| | CR965 | 32-91-1800 | DIODE Si VZ5.3-6.0V RD5.6J-B NEC |
| | CR966 | 32-91-1800 | DIODE Si VZ5.3-6.0V RD5.6J-B NEC |
| | Q961 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| | Q962 | 30-31-7301 | TR Si NPN 2SC1730-L NEC |
| | Q963 | 30-32-3710 | TR Si NPN 2SC2371-L NEC |
| | Q964 | 30-32-3710 | TR Si NPN 2SC2371-L NEC |
| | Q965 | 30-32-3710 | TR Si NPN 2SC2371-L NEC |
| | Q966 | 30-32-3710 | TR Si NPN 2SC2371-L NEC |
| | R961 | 48-12-2200 | R VAR M FILM 2KΩ |
| | R962 | 40-27-2682 | R FXD C FILM 6.8KΩ 5% 1/4W |
| | R963 | 40-27-2682 | R FXD C FILM 6.8KΩ 5% 1/4W |
| | R965 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| | R966 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| | R967* | | NO USED IN THIS MODEL |
| | R968 | 40-27-3392 | R FXD C FILM 39KΩ 5% 1/4W |
| | R969 | 40-27-3392 | R FXD C FILM 39KΩ 5% 1/4W |
| | R970 | 40-27-0102 | R FXD C FILM 10Ω 5% 1/4W |
| | R971 | 40-27-0102 | R FXD C FILM 10Ω 5% 1/4W |
| | R973 | 40-27-1392 | R FXD C FILM 390Ω 5% 1/4W |
| | R974 | 40-27-1392 | R FXD C FILM 390Ω 5% 1/4W |
| | R975 | 42-74-4100 | R FXD M FILM 100KΩ 5% 1/2W |
| | R976 | 42-74-4100 | R FXD M FILM 100KΩ 5% 1/2W |
| | R977 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| | R978 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| | R979 | 40-37-3680 | R FXD M OX 68KΩ 5% 1W |
| | R980 | 40-37-3680 | R FXD M OX 68KΩ 5% 1W |
| | R981 | 40-27-2122 | R FXD C FILM 1.2KΩ 5% 1/4W |
| | R982 | 40-27-2122 | R FXD C FILM 1.2KΩ 5% 1/4W |
| A13 | PCB-S | 90-50-2131 | PCB-S A13 Z AXIS & CRT CIRCUIT |
| | C1011 | 52-03-3469 | C FXD CER 0.01μF 500V |
| | C1012 | 52-03-3469 | C FXD CER 0.01μF 500V |
| | C1013 | 52-03-3469 | C FXD CER 0.01μF 500V |
| | C1014 | 52-03-3469 | C FXD CER 0.01μF 500V |
| | C1015 | 52-03-3469 | C FXD CER 0.01μF 500V |
| | C1016 | 54-00-0311 | C FXD ELECT 10μF 50V |
| | C1017 | 52-05-2468 | C FXD CER 0.01μF 50V |
| | C1018 | 52-05-2468 | C FXD CER 0.01μF 50V |
| | C1019 | 52-01-3345 | C FXD CER 1000PF 500V |
| | C1020 | 57-10-1190 | C VAR CER 2-10PF |
| | C1021 | 52-06-3051 | C FXD CER 5PF 500V |
| | C1022 | 52-05-2468 | C FXD CER 0.01μF 50V |
| | C1023 | 52-05-2468 | C FXD CER 0.01μF 50V |
| | C1024 | 52-03-3469 | C FXD CER 0.01μF 500V |
| | C1025 | 52-06-3010 | C FXD CER 1PF 500V |
| | C1026 | 57-10-1180 | C VAR CER 1.5-4PF |
| | C1027 | 52-05-2468 | C FXD CER 0.01μF 50V |
| | C1028 | 52-03-3469 | C FXD CER 0.01μF 500V |
| | C1029 | 52-05-1498 | C FXD CER 0.1μF 25V |

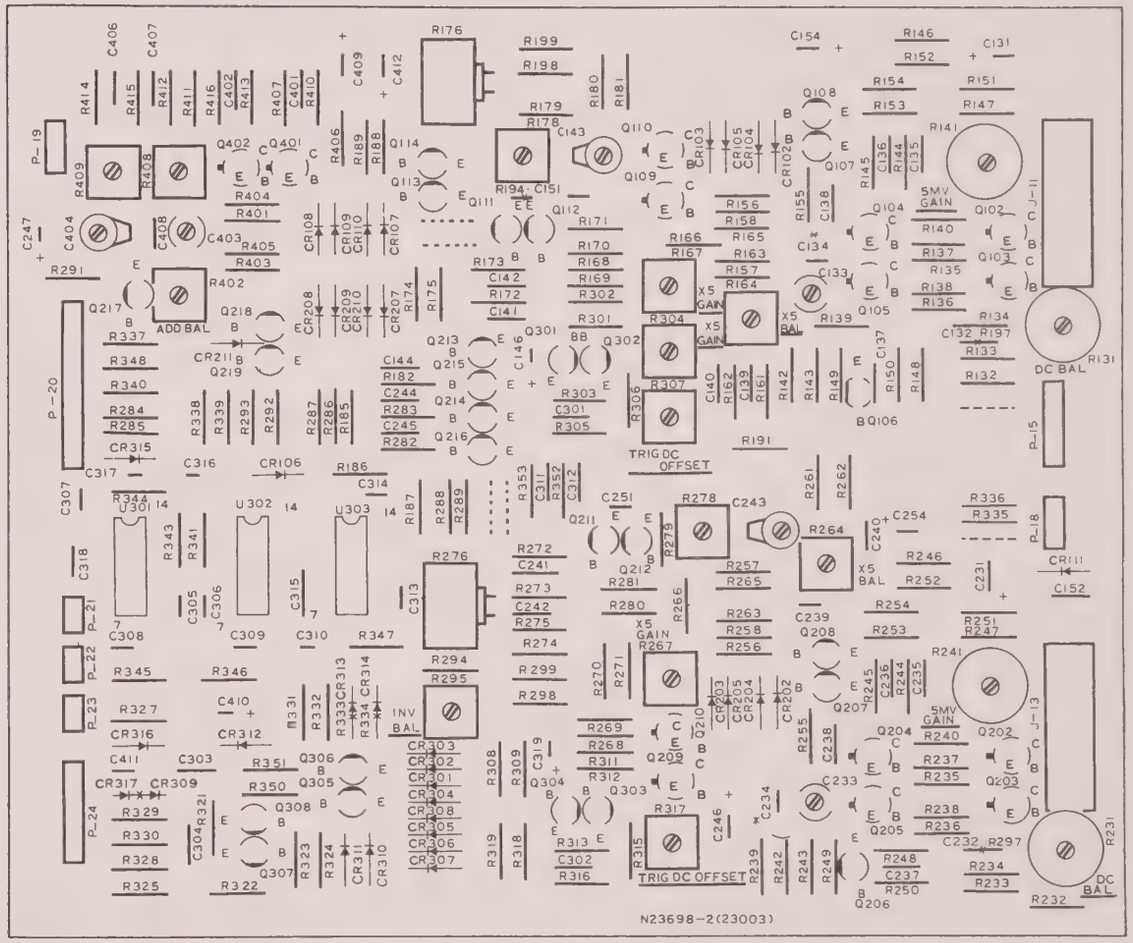
| REFERENCE DESIGNATOR | | KIKUSUI PARTS NO. | DESCRIPTION |
|---|---|---|---|
| A13 | C1030 | 52-05-2468 | C FXD CER 0.01μF 50V |
| | C1031 | 52-01-5345 | C FXD CER 1000PF 2KV |
| | C1032 | 52-01-5345 | C FXD CER 1000PF 2KV |
| | C1033 | 52-01-5345 | C FXD CER 1000PF 2KV |
| | C1036 | 52-03-3469 | C FXD CER 0.01μF 500V |
| | C1037 | 52-01-5345 | C FXD CER 1000PF 2KV |
| | C1038 | 52-01-5345 | C FXD CER 1000PF 2KV |
| | C1039 | 52-01-5345 | C FXD CER 1000PF 2KV |
| | C1040 | 52-01-5345 | C FXD CER 1000PF 2KV |
| | C1041 | 52-01-5345 | C FXD CER 1000PF 2KV |
| | CR1011 | 32-11-5880 | DIODE 1S1588 TOSHIBA |
| | CR1012 | 32-11-5880 | DIODE 1S1588 TOSHIBA |
| | CR1013 | 32-11-5880 | DIODE 1S1588 TOSHIBA |
| | CR1014 | 32-11-5880 | DIODE 1S1588 TOSHIBA |
| | CR1015 | 32-30-0830 | DIODE 1SS83 HITACHI |
| | CR1016 | 32-11-5880 | DIODE 1S1588 TOSHIBA |
| | CR1017 | 32-11-5880 | DIODE 1S1588 TOSHIBA |
| | CR1018 | 32-11-5880 | DIODE 1S1588 TOSHIBA |
| | CR1019 | 32-30-0830 | DIODE 1SS83 HITACHI |
| | CR1020 | 32-30-0830 | DIODE 1SS83 HITACHI |
| | CR1021 | 32-30-0830 | DIODE 1SS83 HITACHI |
| | CR1022 | 32-30-0830 | DIODE 1SS83 HITACHI |
| | CR1023 | 32-30-0830 | DIODE 1SS83 HITACHI |
| | CR1024 | 32-30-0830 | DIODE 1SS83 HITACHI |
| | CR1025 | 39-00-0090 | SURGE ABSORBER ERZ-C10DK471 |
| | CR1026 | 32-90-0290 | DIODE ZENER 02Z15A TOSHIBA |
| | CR1027 | 32-30-0830 | DIODE 1SS83 HITACHI |
| | CR1028 | 32-30-0830 | DIODE 1SS83 HITACHI |
| | CR1029 | 32-30-0830 | DIODE 1SS83 HITACHI |
| | CR1030 | 32-30-0830 | DIODE 1SS83 HITACHI |
| | CR1031 | 32-11-5880 | DIODE 1S1588 TOSHIBA |
| | CR1033 | 32-11-5880 | DIODE 1S1588 TOSHIBA |
| | Q1011 | 30-31-7301 | TR 2SC1730-L NEC |
| | Q1012 | 30-31-7301 | TR 2SC1730-L NEC |
| | Q1013 | 30-40-6681 | TR 2SD668A HITACHI |
| | Q1014 | 30-32-3710 | TR 2SC2731-L NEC |
| | Q1016 | 30-40-6681 | TR 2SD668A HITACHI |
| | Q1017 | 30-32-3710 | TR 2SC2371-L NEC |
| | Q1019 | 30-10-8381 | TR 2SA838-B MATSUSHITA |
| | R1011 | 48-26-4101 | R VAR M FILM 100KΩ |
| | R1012 | 40-27-0222 | R FXD C FILM 22Ω 5% 1/4W |
| | R1013 | 48-26-4101 | R VAR M FILM 100KΩ |
| | R1014 | 40-27-0222 | R FXD C FILM 22Ω 5% 1/4W |
| | R1015 | 48-26-4101 | R VAR M FILM 100KΩ |
| | R1016 | 40-27-0222 | R FXD C FILM 22Ω 5% 1/4W |
| | R1017 | 48-26-4101 | R VAR M FILM 100KΩ |
| | R1018 | 40-27-4472 | R FXD C FILM 470KΩ 5% 1/4W |
| | R1020 | 40-27-0332 | R FXD C FILM 33Ω 5% 1/4W |
| | R1021 | 40-27-2392 | R FXD C FILM 3.9KΩ 5% 1/4W |
| | R1022 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| | R1023 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| | R1024 | 40-27-3392 | R FXD C FILM 39KΩ 5% 1/4W |
| | R1025 | 40-27-1562 | R FXD C FILM 560Ω 5% 1/4W |
| | R1026 | 40-27-1392 | R FXD C FILM 390Ω 5% 1/4W |
| | R1027 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| | R1028 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| | R1029 | 44-91-3680 | R FXD M OX 68KΩ 5% 1W |
| | R1030 | 44-91-3680 | R FXD M OX 68KΩ 5% 1W |
| | R1031 | 40-27-1122 | R FXD C FILM 120Ω 5% 1/4W |
| | R1032 | 40-27-0682 | R FXD C FILM 68Ω 5% 1/4W |
| | R1033 | 40-27-3562 | R FXD C FILM 56KΩ 5% 1/4W |
| | R1034 | 40-27-3822 | R FXD C FILM 82KΩ 5% 1/4W |
| | R1035 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| | R1036 | 40-37-4121 | R FXD C FILM 120KΩ 5% 1/2W |
| | R1037 | 40-27-1122 | R FXD C FILM 120Ω 5% 1/4W |
| | R1038 | 40-37-5101 | R FXD C FILM 1MΩ 5% 1/2W |
| | R1039 | 40-37-6101 | R FXD C FILM 10MΩ 5% 1/2W |
| | R1040 | 40-37-6101 | R FXD C FILM 10MΩ 5% 1/2W |
| | R1041 | 48-26-5100 | R VAR M FILM 1MΩ CR19R1MΩ |
| | R1042 | 42-44-0260 | R FXD M GLAZE 2.5MΩ 1% 1.6W |
| | R1043 | 40-27-2562 | R FXD C FILM 5.6KΩ 5% 1/4W |
| | R1044 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| | R1045 | 40-27-2332 | R FXD C FILM 3.3KΩ 5% 1/4W |
| | R1046 | 40-37-5221 | R FXD C FILM 2.2MΩ 5% 1/2W |
| | R1047 | 40-37-5101 | R FXD C FILM 1MΩ 5% 1/2W |
| | R1048 | 40-37-6101 | R FXD C FILM 10MΩ 5% 1/2W |
| | R1049 | 40-37-6101 | R FXD C FILM 10MΩ 5% 1/2W |
| | R1050 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| | R1051 | 42-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| | R1052 | 42-44-0260 | R FXD M GLAZE 2.5MΩ 1% 1.6W |
| | R1053 | 42-44-0260 | R FXD M GLAZE 2.5MΩ 1% 1.6W |
| | R1054 | 42-72-2560 | R FXD M FILM 5.6KΩ 1% 1/4W |
| | R1055 | 42-72-2680 | R FXD M FILM 6.8KΩ 1% 1/4W |
| | R1056 | 48-29-2500 | R VAR M FILM 5KΩ |
| | R1057 | 42-72-3190 | R FXD M FILM 19KΩ 1% 1/4W |
| | R1058 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| | R1059 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| | R1061 | 40-27-0102 | R FXD C FILM 10Ω 5% 1/4W |
| | R1062 | 40-27-0102 | R FXD C FILM 10Ω 5% 1/4W |
| | R1063 | 40-27-0102 | R FXD C FILM 10Ω 5% 1/4W |
| | V1002 | 23-70-0000 | LAMP NEON NE-2 |
| | V1003 | 23-70-0000 | LAMP NEON NE-2 |

| REFERENCE DESIGNATOR | KIKUSUI PARTS NO. | DESCRIPTION |
|---|---|---|
| A14 PCB-S A14 | 90-50-2141 | PCB-S A14 HV REGULATOR |
| C1071 | 50-67-0060 | C FXD PLSTC 0.1μF 100V |
| C1072 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C1073 | 54-00-0311 | C FXD ELECT 10μF 50V |
| C1074 | 54-00-0314 | C FXD ELECT 47 μF 50V |
| C1075 | 52-98-1010 | C FXD CER 4700PF 3KV |
| C1076 | 52-98-1010 | C FXD CER 4700PF 3KV |
| C1077 | 52-98-1010 | C FXD CER 4700PF 3KV |
| C1078 | 50-67-0060 | C FXD PLSTC 0.1μF 100V |
| C1079 | 52-08-5145 | C FXD CER 22PF 2KV |
| CR1071 | 32-90-1820 | DIODE Si ERB26-20FUJITSU |
| CR1072 | 32-90-1820 | DIODE Si ERB26-20 FUJITSU |
| Q1071 | 30-30-9001 | TR Si NPN 2SC900 NEC |
| Q1072 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q1073 | 30-10-8381 | TR Si PNP 2SA838-B MATSUSHITA |
| Q1074 | 30-40-8802 | TR Si NPN 2SD880-Y TOSHIBA |
| R1071 | 40-27-1102 | R FXD C FILM 100Ω 5% 1/4W |
| R1072 | 40-27-1682 | R FXD C FILM 680Ω 5% 1/4W |
| R1073 | 40-27-4222 | R FXD C FILM 220KΩ 5% 1/4W |
| R1074 | 40-27-2222 | R FXD C FILM 2.2KΩ 5% 1/4W |
| R1075 | 40-27-0332 | R FXD C FILM 33Ω 5% 1/4W |
| R1076 | 40-27-2102 | R FXD C FILM 1KΩ 5% 1/4W |
| R1077 | 40-37-8222 | R FXS C FILM 2.2Ω 5% 1/2W |
| R1078 | 40-27-8472 | R FXD C FILM 4.7Ω 5% 1/4W |
| R1079 | 40-37-3681 | R FXD C FILM 68KΩ 5% 1/2W |
| R1080 | 40-37-4471 | R FXD C FILM 470KΩ 5% 1/2W |
| R1081 | 40-27-8472 | R FXD C FILM 4.7Ω 5% 1/4W |
| T1001 | 63-92-0060 | T DC-DC CONV, TRANS S751094 |
| A15 PCB-S A15 | 90-50-2150 | PCB-S A15 HV MULTI. |
| CR1081-CR1091 | 32-90-1820 | DIODE Si ERB26-20 FUJITSU |
| C1081-C1091 | 52-01-5345 | C FXD CER 1000PF 2KV |
| R1091 | 40-37-5101 | R FXD C FILM 1MΩ 5% 1/2W |
| A16 PCB-S A16 | 90-50-2161 | PCB-S A16 ILLUM |
| DS101-DS103 | 23-35-0040 | LAMP FILAMENT 8V 0.1A BQ041-22803A |

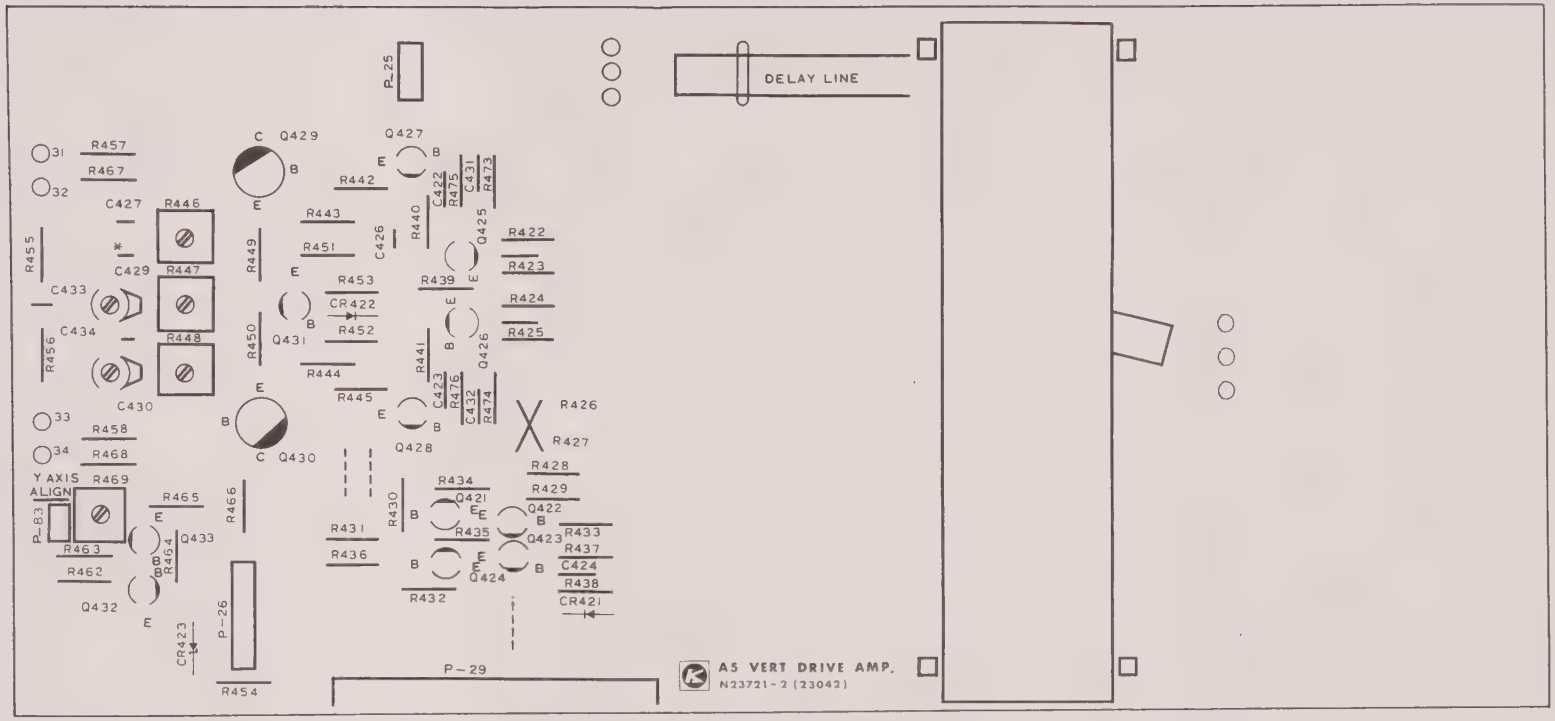
| REFERENCE DESIGNATOR | KIKUSUI PARTS NO. | DESCRIPTION |
|---|---|---|
| MISCELLANEOUS | | |
| C501 | 50-67-0060 | C FXD PLSTC 0.1μF 100V |
| C502 | 52-06-3185 | C FXD CER 47PF 500V |
| C503 | 52-06-3145 | C FXD CER 22PF 500V |
| C504 | 52-06-2245 | C FXD CER 150PF 50V |
| C1101 | 52-77-1000 | C FXD CER 1000PF 250VAC |
| C1102 | 52-77-1000 | C FXD CER 1000PF 250VAC |
| CR101 | 37-00-0040 | LED LMP RED TLR104 |
| CR201 | 37-00-0040 | LED LMP RED TLR104 |
| CR364 | 37-00-0050 | LED LMP CLEAR TLR106 |
| CR365 | 37-00-0050 | LED LMP CLEAR TLR106 |
| CR721 | 37-00-0140 | LED LMP GREEN TLG103 |
| CR722 | 37-00-0050 | LED LMP CLEAR TLR106 |
| CR723 | 37-00-0050 | LED LMP CLEAR TLR106 |
| CR862 | 37-00-0040 | LED LMP RED TLR104 |
| CR1001 | 37-00-0050 | LED LMP GREEN TLG105 |
| F1101 | 99-02-0120 | FUSE 250V 1A FGT41 |
| F1101 | 99-02-0115 | FUSE 250V 0.5A FGT41 |
| L1001 | 66-21-0040 | COIL ROTATION S-7809293 |
| Q1101 | 30-40-3811 | TR Si NPN 2SD381-L NEC |
| Q1105 | 30-20-5361 | TR Si PNP 2SB536 NEC |
| Q1106 | 30-40-3811 | TR Si NPN 2SD381-L |
| Q1108 | 30-40-3811 | TR Si NPN 2SD381-L |
| R101 | 40-27-0222 | R FXD C FILM 22Ω 5% 1/4W |
| R201 | 40-27-0222 | R FXD C FILM 22Ω 5% 1/4W |
| R380 | 40-27-0562 | R FXD C FILM 56Ω 5% 1/4W |
| R381 | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| R382 | 40-27-0472 | R FXD C FILM 47Ω 5% 1/4W |
| R501 | 42-73-4900 | R FXD M FILM 900KΩ 1% 1/2W |
| R502 | 42-71-4111 | R FXD M FILM 111KΩ 1% 1/2W |
| R503 | 40-27-3472 | R FXD M FILM 47KΩ 5% 1/4W |
| R612 (WITH S601) | 45-01-0410 | R VAR C COMP 100K RV16YN-15SB100K ME |
| R773 | 49-26-3100 | R VAR M 10T 22S10 POTENTIOMETER 10KΩ |
| R835 (WITH SW802) | 45-01-0380 | R VAR C COMP 5KΩ V16L4 (7x5) (PH)S-10SB5KΩ |
| R991 | 45-02-0200 | R VAR C COMP 10KΩ+10KΩ V16L4GN20(6)R30(3.2)RB10K+B10KΩ |
| S301 | 81-03-0150 | SW PUSH KSD3-6-10LLDC |
| S501 | 82-71-0060 | SW LEVER J19-124 |
| S502 | 82-71-0060 | SW LEVER J19-124 |
| S602 | 81-02-0080 | SW PUSH KDS2-4-10 LLDC |
| SW801 | 80-99-0030 | SW ROTARY TIME/DIV |
| SW802 | - | SEE R835 (A PART OF R835) |
| S601 | - | SEE R612 (A PART OF R612) |
| T1101 | 60-48-0010 | P.T 5630 |
| V1001 | 21-46-0602 | CRT 150BFB31 HITACHI |
| MULTI DIAL | W1-000-012 | MULTI DIAL CA-10 |
| AC CORD CONNECTOR | 83-20-3010 | AC CORD CONNECTOR CM-3 |
| AC CORD | 85-10-0120 | AC CORD SET |
| PROBE | 89-03-0180 | MODEL 959A BNC (1m) PROBE |
| KNOB | N1-000-171 | KNOB R12SB-3.2 12ø SINGLE BLACK |
| KNOB | N1-000-011 | KNOB R12SB 12ø SINGLE FOR POSITION |
| KNOB | N1-000-181 | KNOB R 10SB-3.2 |
| KNOB | N1-000-051 | KNOB D22WB (BLACK) |
| KNOB | N2-000-011 | KNOB R12WR (RED) |
| KNOB | N1-000-191 | KNOB R42WB |
| PUSH BUTTON | P2-000-201 | PUSH BUTTON BLACK |
| PUSH BUTTON | P2-000-211 | PUSH BUTTON BLUE |
| PUSH BUTTON | P2-000-281 | PUSH BUTTON GREEN |
| BEZEL | P2-050-111 | BEZEL (SQUARE 5 INCHES) |
| FILTER | S4-563-0111 | SCREEN FILTER (BLUE) |
| CARRYING HANDLE | E6-050-052 | CARRYING HANDLE |
| HOLDER CORD | P2-000-271 | HOLDER LINE CORD |



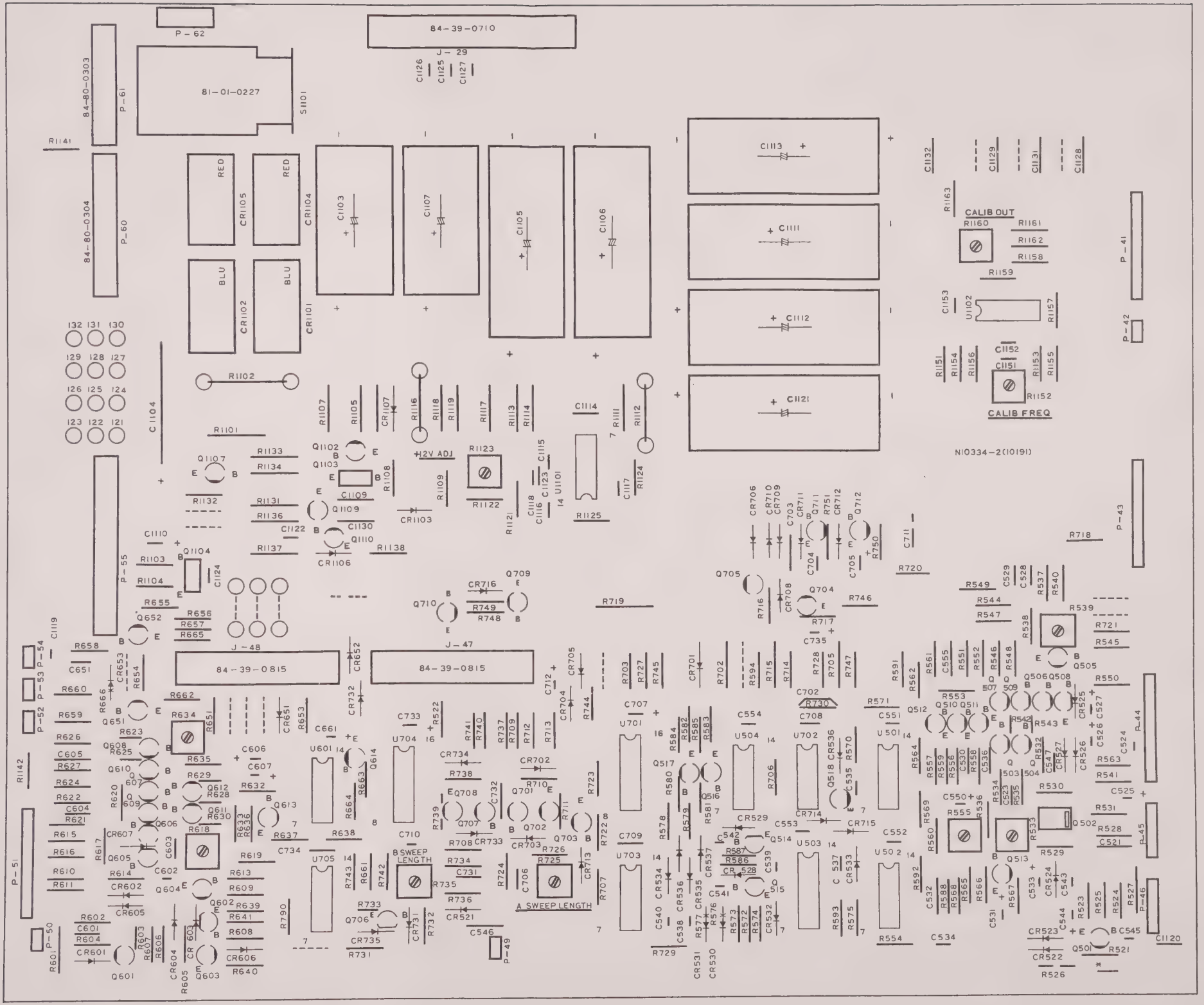

A1 VERT ATT Parts Location



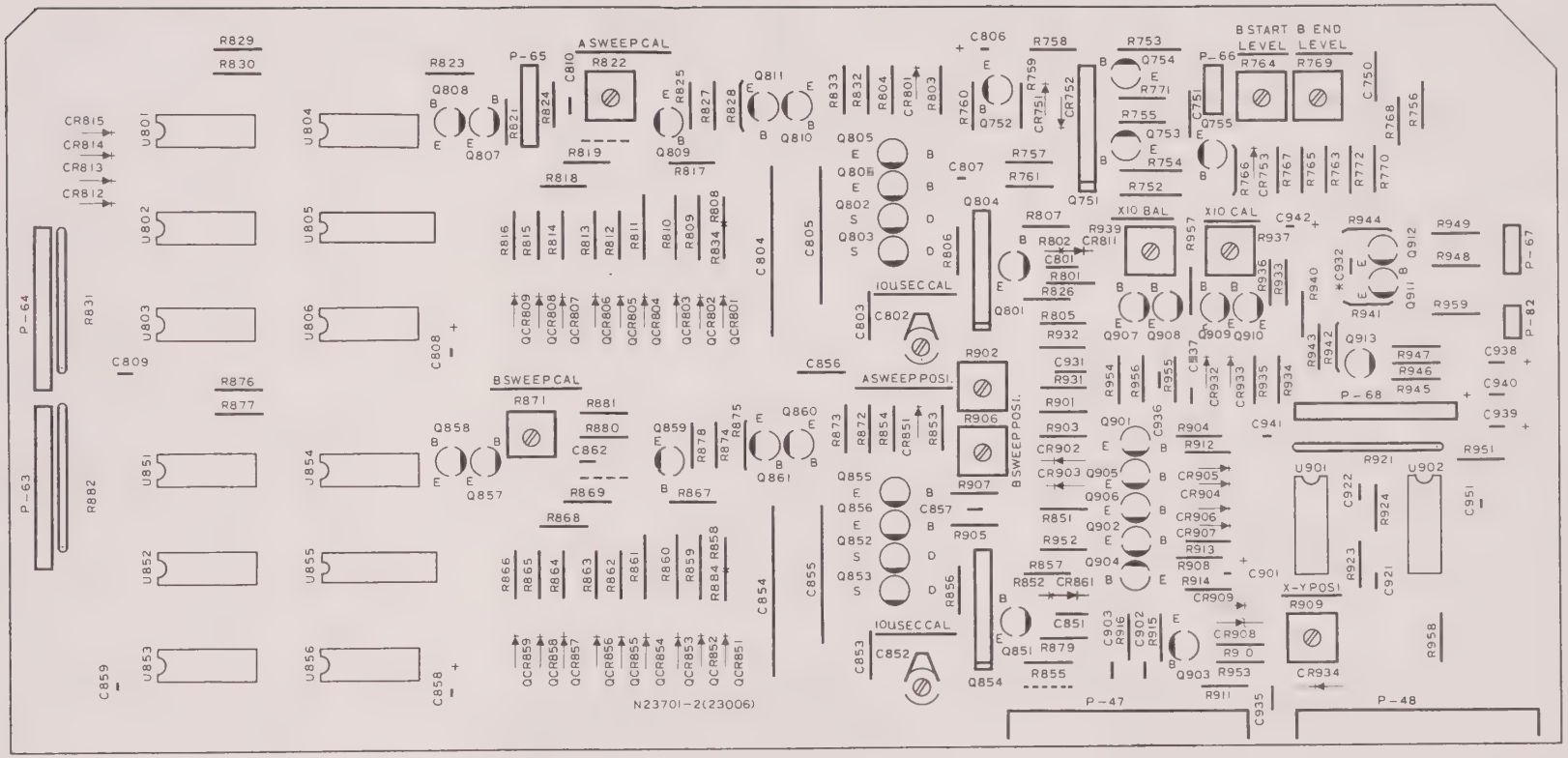

A4 VERT PREAMP Parts Location



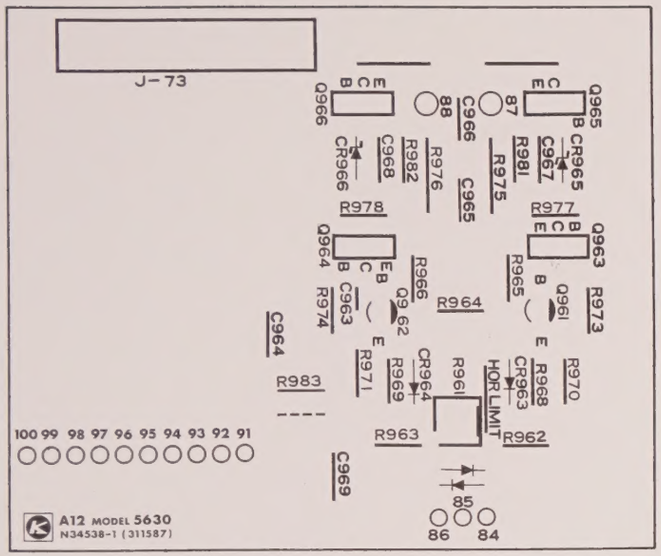

A5 VERT DRIVE AMP Parts Location



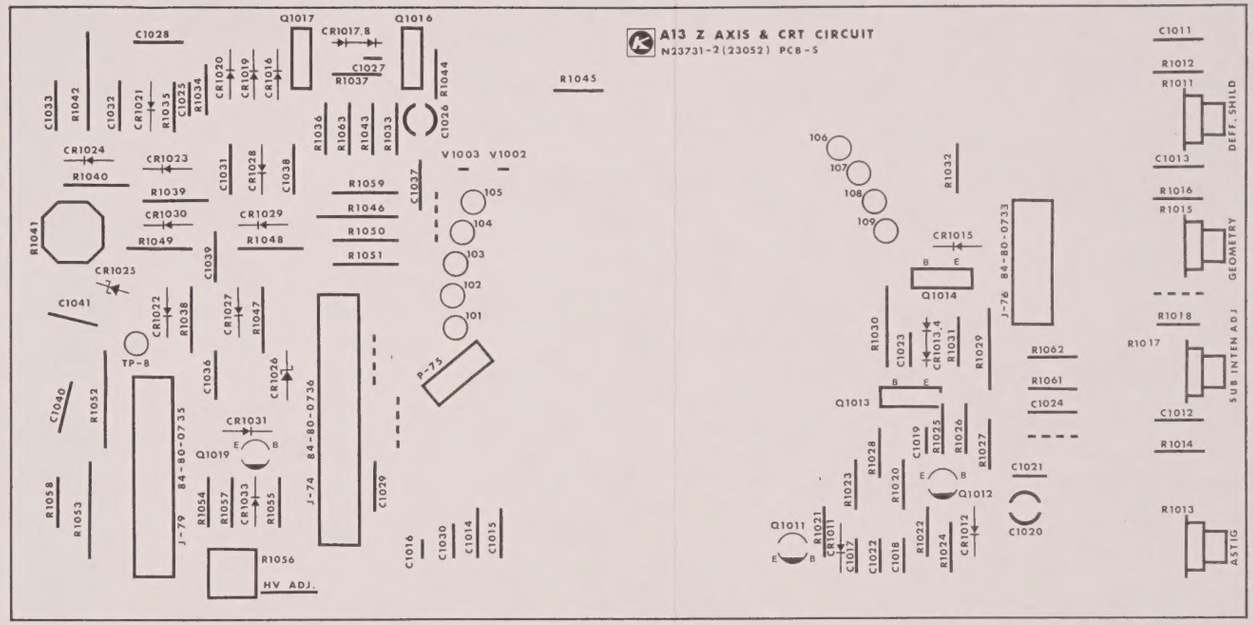

A9 TRIG & POWER SUPPLY Parts Location



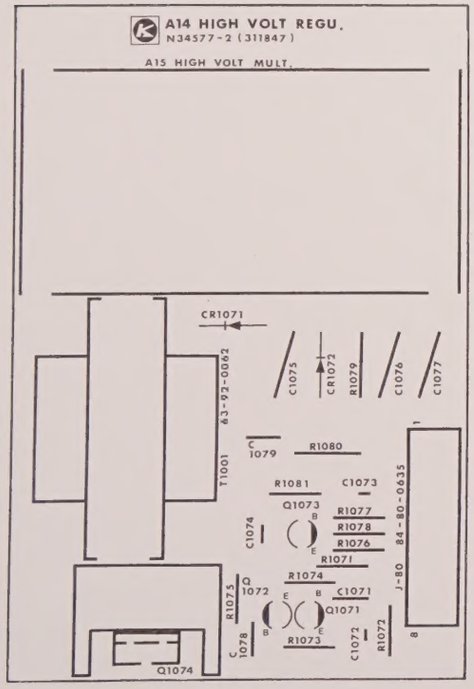

A10 SWEEP & HORIZ DRIVE Parts Location



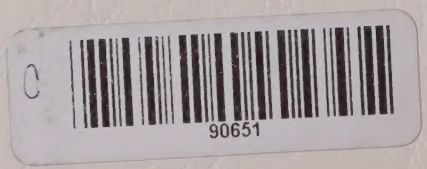

A12 HORIZ OUTPUT AMP Parts Location




A13 Z AXIS & CRT CIRCUIT Parts Location




A14 HV REGULATOR Parts Location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